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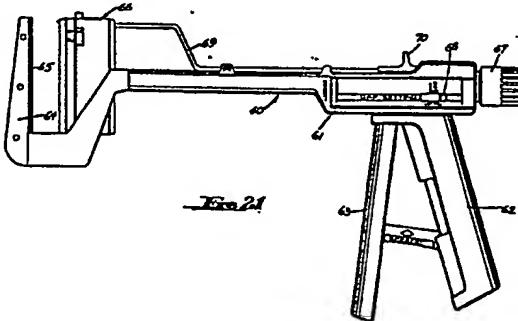
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⑯ Multiple-Load cartridge assembly for a linear surgical stapling instrument.

⑰ A multiple-load cartridge assembly for use with a linear surgical stapling instrument of the type which, when actuated, simultaneously implants at least one row of staples in the tissue of a patient and forms or clinches the staples of the row against the instrument anvil. The cartridge assembly comprises a cartridge having a row of staple-containing forming pockets and a driver having a plurality of blades equal in number to the number of forming pockets and configured to drive the staples from the forming pockets through the tissue to be sutured and against the instrument anvil to be clinched, when the surgical stapling instrument is actuated. The cartridge has at least one row of storage pockets, equal in number to the forming pockets, and each containing at least one staple. An indexing mechanism is provided to shift the at least one staple in each storage pocket to the line of action between the driver and the anvil after the first actuation of the surgical stapling instrument, for at least another actuation of the surgical stapling instrument. A safety interlock within the cartridge assembly assures correct sequential operation of the cartridge assembly and prevents jamming thereof. An indicator visually shows the number of the load of staples ready to be implanted and formed.



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1        MULTIPLE-LOAD CARTRIDGE ASSEMBLY  
          FOR A LINEAR SURGICAL STAPLING INSTRUMENT

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5        TECHNICAL FIELD

The invention relates to a cartridge assembly for a linear surgical stapling instrument, and more particularly to such a cartridge assembly containing more than one load of surgical staples, thereby enabling the surgical stapling instrument to be actuated more than once before changing surgical stapling instruments or reloading or replacing the cartridge.

BACKGROUND ART

In recent years, there has been an increasing number 15 of surgeons using surgical staples, rather than conventional sutures. This is true because the use of surgical staples and surgical stapling instruments has rendered many difficult procedures much simpler. Of even more 20 importance, however, is the fact that the use of surgical staples significantly reduces the time required for most procedures and, therefore, reduces the length of time for which the patient must be maintained under anesthetic.

Many types of surgical stapling instruments have been 25 devised for many different procedures. The present invention is directed to a linear surgical stapling instrument. This is an instrument which, on a single actuation, simultaneously implants and forms at least one rectilinear row of surgical staples. Such instruments are used on many different organs and tissues, such as 30 the lung, the esophagus, the stomach, the duodenum, and throughout the intestinal tract.

In its earliest form, the linear surgical stapling 35 instrument was a permanent, multi-use instrument, and the surgical staples were manually loaded into the instrument one-by-one. An exemplary surgical stapling instrument of

1 this type is taught in U.S. Patent No. 3,080,564. While  
such instruments performed well, they were, in general,  
complex in construction, expensive to manufacture, heavy,  
bulky and difficult both to load with surgical staples  
5 and to clean and sterilize after each use.

A significant improvement in the linear surgical  
stapling instrument came about with the provision of pre-  
sterilized, disposable loading units or staple cart-  
ridges. U.S. Patent No. 3,275,211 and U.S. Patent No.  
10 3,589,589 are exemplary of those relating to permanent,  
multi-use, linear instruments having replaceable staple  
cartridges. While this improvement significantly reduced  
the time previously required for hand-loading of the  
15 staples, the basic instrument still had to be disassem-  
bled, cleaned, reassembled and sterilized for each proce-  
dure, and frequently required additional maintenance and  
adjustment. Also, if more than one load of staples was  
required in a given procedure, the cartridge had to be  
20 replaced each time, as it contained only a single load.

Even more recently, in view of rising hospital costs,  
there has been an ever increasing interest in disposable  
surgical stapling instruments, to eliminate as much work  
as possible (i.e., disassembling, cleaning, reassembling,  
sterilization and the like) and to be more efficient,  
25 while at the same time not having to compromise the surgi-  
cal procedures.

Such a disposable linear surgical stapling instrument  
is taught, for example, in co-pending application Serial  
No. 06/503,231, filed June 10, 1983, in the names of  
30 Hector Chow and Hugh Melling, and entitled "DISPOSABLE  
LINEAR SURGICAL STAPLING INSTRUMENT". This instrument,  
simple in construction and relatively inexpensive to manu-  
facture, is characterized by a working gap or range of  
distances between the instrument anvil and the cartridge  
35 over which a single size staple can be properly implanted

1 and formed. The proper and desired setting of the instrument, within the working gap, is easily accomplished  
2 through simple manipulation of an adjustment knob at the  
3 rear of the instrument with indicator means on each side  
4 of the instrument to clearly show when the distance  
5 between the anvil and the cartridge is within the working  
6 gap. In addition, the gap to which the instrument is set  
7 can fall anywhere within the confines of the working gap  
8 of the instrument. The instrument is provided with an  
9 alignment and retaining pin, shiftable to an operable  
10 position wherein alignment between the anvil and the  
11 staple cartridge is ensured, and wherein tissue to be  
12 sutured, located between these elements, is retained  
13 therebetween. The instrument is provided with a lockout  
14 device which precludes rotation of the adjustment knob to  
15 secure the desired gap unless the alignment and retaining  
16 pin has been shifted to its operative position. The  
17 instrument is also provided with a novel trigger safety  
18 which will disable the trigger until the movable jaw of  
19 the instrument has been shifted to a position near the  
20 working gap.

21 For purposes of economy and simplicity, much of the  
22 instrument is made of appropriate plastic material, while  
23 most of the major load-bearing elements of the instrument  
24 are metallic. The instrument is so designed that the  
25 staple driver is coupled to the trigger at all times. As  
26 a result of this, the driver is not free floating and  
27 cannot accidentally dislodge or discharge the surgical  
28 staples during shipping and handling prior to use of the  
29 instrument in the operating room.

30 As indicated above, linear surgical stapling instruments (whether they be permanent, reusable instruments or  
31 disposable, single-use instruments) are characterized by  
32 the fact that they simultaneously form and implant at  
33 least one rectilinear row of surgical staples. In fact,

1 the most commonly encountered linear surgical stapling  
instrument simultaneously forms and implants two recti-  
linear rows of surgical staples, with the surgical  
staples of one row being offset or staggered with respect  
5 to the surgical staples of the other row. This assures  
reliable suturing of the tissue to be joined together.

It has been found that it would be a matter of great  
convenience to the surgeon if the staple cartridge would  
contain more than one load of surgical staples. The word  
10 "load" used here and hereinafter refers to that number of  
staples required to make up the single or double row of  
staples implanted when the surgical stapling instrument  
is actuated. This would enable the surgeon to perform  
two or more suturing procedures before changing cart-  
15 ridges in a permanent or disposable multiple-use instru-  
ment or changing instruments in the case of a disposable  
instrument.

As a consequence, the present invention is directed  
to a multiple-load cartridge assembly for a linear surgi-  
20 cal stapling instrument. Depending upon the materials  
from which the elements of the cartridge of the present  
invention are made and the manner in which they are assem-  
bled, the cartridge may be provided in a number of forms.  
For example, the cartridge can constitute a reusable,  
25 refillable cartridge to be used with a permanent, non-  
disposable linear surgical stapling instrument. The  
cartridge can be a replaceable and disposable cartridge  
for a permanent instrument. The cartridge can be a  
 reusable, refillable cartridge for a disposable instru-  
30 ment. The cartridge can be a replaceable and disposable  
cartridge for a disposable instrument. Finally, the  
cartridge can constitute a permanent part of a disposable  
instrument, the instrument and cartridge being disposed  
of when the cartridge is empty.

1

DISCLOSURE OF THE INVENTION

According to the invention, there is provided a multiple-load cartridge assembly for use with a linear surgical stapling instrument of the type which, when actuated, simultaneously implants at least one row of staples in the tissue of a patient, and forms or clinches the staples of the row against the instrument anvil.

In its simplest form, the cartridge assembly comprises a cartridge having at least one row of staple-containing forming pockets and a driver having a plurality of blades equal in number to the number of forming pockets. The driver blades are configured to drive the staples from the forming pockets through the tissue to be sutured and against the tool anvil to be clinched, when the surgical stapling instrument is actuated. The cartridge also has a plurality of storage pockets, equal in number to the forming pockets and each containing one staple. After the first actuation of the surgical stapling instrument, an indexing mechanism, mounted within the cartridge, shifts the staple in each storage pocket into the adjacent forming pocket, to reload the forming pockets for another actuation of the surgical stapling instrument. An interlock may be located within the cartridge and prevents actuation of the indexing mechanism until the forming pockets have been cleared of the first staple load. In this way, correct sequential operation of the cartridge is assured and jamming of the cartridge is precluded.

In a second embodiment of the invention, each storage pocket may contain a plurality of surgical staples arranged one behind the other in a row extending perpendicular to the driver. Upon each actuation of the driver and return thereof to its retracted position, an indexing member shifts a staple from each storage pocket to each forming pocket. A third embodiment is similar to the

1 second embodiment with the exception that each row of  
5 staples in each storage pocket extends diagonally with  
10 respect to the driver.

15 In a fourth embodiment, a staging pocket is located  
20 between each holding pocket and each forming pocket. An  
25 indexing mechanism is provided to shift a staple from the  
30 storage pocket to the staging pocket. A second indexing  
35 mechanism is provided to shift a staple from the staging  
40 pocket to the forming pocket. In yet another embodiment  
45 having a storage pocket and a staging pocket for each  
50 forming pocket, the staples are stacked one above the  
55 other in the storage pocket and are fed automatically by  
60 spring means or the like into the staging pocket. An  
65 indexing mechanism is provided to shift a staple from the  
70 staging pocket to the forming pocket.

75 To demonstrate the application of the present invention  
80 to an existing linear surgical stapling instrument,  
85 there is taught herein an embodiment of the cartridge of  
90 the present invention constituting a permanent part of a  
95 disposable linear surgical stapling instrument of the  
100 type described in the above noted co-pending application.  
105 The cartridge contains two loads of staples and the  
110 linear surgical stapling instrument is capable of two  
115 actuations, forming and implanting two staggered rows of  
120 surgical staples with each actuation of the instrument.  
125 Thereafter, the instrument and its cartridge are disposed  
130 of. The cartridge assembly comprises a cartridge having  
135 two staggered parallel rows of forming pockets and a storage  
140 pocket for each forming pocket. Each forming pocket  
145 and each storage pocket contains one surgical staple. A  
150 driver is provided having a driving blade for each forming  
155 pocket. The cartridge assembly is provided with a casing  
160 which is mounted on the cartridge with a support  
165 plate therebetween. The driver is mounted within the  
170 casing, with its driving blades extending through the

1 support plate and into the cartridge.

A slider is provided for each row of storage pockets. The sliders are actuated by a manual indexing button 5 slidably mounted in the casing. When the button is manually shifted, it will shift the sliders which, in turn, will index the staples in the storage pockets into their respective forming pockets. A safety is provided to preclude actuation of the indexing button until the linear surgical stapling instrument has been once actuated to 10 clear the forming pockets of their first staple load. Thereafter, when the driver is returned to its normal retracted position, the indexing button can be shoved inwardly with respect to the casing, causing the sliders to shift the staples in the storage pockets into their 15 respective forming pockets, providing a second load of staples in the forming pockets and enabling a second actuation of the instrument.

In another embodiment of the invention, one or more 20 sets of storage pockets, each containing one staple, are provided and are arranged identically to the forming pockets. The first set of forming pockets and all the sets of storage pockets are movable with respect to the instrument centerline through any appropriate path of travel (rectilinear, arcuate, etc). After the first 25 actuation of the instrument, which clears the first forming pockets, and when the driver is retracted, the at least one more set of storage pockets can be moved into alignment between the driver and the anvil, displacing the first set of empty forming pockets. These storage 30 pockets thus become forming pockets to allow for at least another actuation of the instrument.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figures 1-4 are diagrammatic representations, partly 35 in cross-section, of a double-load embodiment of the cartridge assembly of the present invention, illustrating its

1 sequential operation.

Figures 5-8 are diagrammatic representations, partly in cross-section, of a multiple-load embodiment of the cartridge assembly of the present invention, illustrating 5 its sequential operation.

Figures 9-12 are diagrammatic representations, partly in cross-section, illustrating an embodiment similar to that of Figures 5-8, with the row of staples in each storage pocket extending diagonally with respect to the 10 driver.

Figures 13-16 are diagrammatic representations, partly in cross-section, of another embodiment having a staging pocket between each storage pocket and forming 15 pocket, and illustrating the sequence of operation thereof.

Figures 17-20 are diagrammatic representations, partly in cross-section, illustrating an embodiment of the present invention similar to that of Figures 13-16, but having a vertical stack of staples in each storage 20 pocket and automatic means to feed staples from each storage pocket to each staging pocket, and further illustrating the mode of operation of this embodiment.

Figure 21 is a side elevational view of an exemplary linear surgical stapling instrument provided with the 25 cartridge assembly of the present invention.

Figure 22 is an exploded perspective view of the cartridge assembly of Figure 21.

Figure 23 is a fragmentary perspective view of the cartridge of the cartridge assembly.

30 Figure 24 is a plan view of the cartridge.

Figure 24A is a fragmentary plan view of the cartridge illustrating one slot comprising a forming pocket and a storage pocket.

35 Figure 25 is a side elevational view of the cartridge.

- 1      Figure 26 is an end elevational view of the cartridge, as seen from the left of Figure 25.
- 5      Figure 27 is an end elevational view of the cartridge, as seen from the right of Figure 25.
- 10     Figure 28 is a cross-sectional view taken along section line 28-28 of Figure 24.
- 15     Figure 29 is an enlarged, fragmentary, simplified plan view of the cartridge.
- 20     Figure 30 is a fragmentary cross-sectional view taken along section line 30-30 of Figure 29.
- 25     Figure 31 is a fragmentary cross-sectional view taken along section 31-31 of Figure 29.
- 30     Figure 32 is a bottom view of the cartridge of the present invention.
- 35     Figure 33 is a bottom view of the driver of the present invention.
- 40     Figure 34 is a side elevational view of the driver of Figure 33.
- 45     Figure 35 is an end elevational view of the driver of Figures 33 and 34.
- 50     Figure 36 is a fragmentary, simplified, semi-diagrammatic plan view of the cartridge, illustrating the position of the driver blades with respect to the cartridge forming and storage pockets.
- 55     Figures 37 and 38 are end elevational views of the sliders of the cartridge assembly.
- 60     Figure 39 is a fragmentary, simplified plan view of the cartridge and a slider, illustrating the slider in its initial, unactuated position.
- 65     Figure 40 is a fragmentary, simplified plan view of the cartridge and the slider of Figure 39, illustrating the slider in its actuated position.
- 70     Figure 41 is a top plan view of the support plate of the present invention.
- 75     Figure 42 is a side elevational view of the support

1 plate.

Figure 43 is an end elevational view of the support plate, as seen from the left of Figure 42.

5 Figure 44 is an end elevational view of the support plate, as seen from the right of Figure 42.

Figure 45 is a plan view of the cartridge, illustrating the sliders and the support plate mounted in place.

Figure 46 is a plan view of the casing of the present invention.

10 Figure 47 is a side elevational view of the casing.

Figure 48 is an end elevational view of the casing, as viewed from the right of Figure 47.

Figure 49 is an end elevational view of the casing, as viewed from the left of Figure 47.

15 Figure 50 is a bottom view of the casing.

Figure 51 is a cross-sectional view, taken along section line 51-51 of Figure 46.

Figure 52 is a plan view of the indexing button.

20 Figure 53 is a side elevational view of the indexing button.

Figure 54 is a bottom view of the indexing button.

Figure 55 is a cross-sectional view taken along section line 55-55 of Figure 52.

25 Figure 56 is an end elevational view of the indexing button, as seen from the left of Figure 53.

Figure 57 is an end elevational view of the indexing button, as seen from the right of Figure 53.

Figure 58 is a fragmentary plan view of the cartridge, with the indexing button mounted therein.

30 Figure 59 is a fragmentary elevational side view of the cartridge and casing with the indexing button mounted therein.

Figure 60 is a plan view of the safety of the present invention.

35 Figure 61 is an end elevational view of the safety.

1      Figure 62 is a side elevational view of the safety.

Figure 63 is a fragmentary, cross-sectional view taken along section line 63-63 of Figure 45 and showing the casing, the driver and the handle plates.

5      Figure 64 is a fragmentary, cross-sectional view taken along section line 64-64 of Figure 45 and showing the casing and the indexing button.

10     Figures 65-68 are diagrammatic representations, partly in cross section, illustrating an embodiment of the invention and its sequential operation wherein the loaded storage pockets move linearly as an array to replace the emptied forming pockets.

15     Figure 69 is a diagrammatic representation, partly in cross section, of an embodiment similar to that of Figures 65-68, with the forming and storage pockets moving in an arcuate path.

#### DETAILED DESCRIPTION OF THE INVENTION

20     Figures 1-20 are simplified diagrammatic representations illustrating the basic concepts of the cartridge assembly of the present invention.

Reference is first made to Figure 1, wherein a cartridge assembly is generally indicated at 1. The anvil of a linear surgical stapling instrument is diagrammatically indicated at 2. The cartridge 1 is provided with a plurality of forming pockets, one of which is shown at 3. A staple 4 is located within the forming pocket 3. It will be understood that, as viewed in Figure 1, the forming pockets 3 will be located one behind the other in a linear row. Each will contain a staple equivalent to staple 4, so that the staples, themselves, will be arranged in a linear row.

30     A staple driver is shown at 5. The staple driver is provided with a blade for each forming pocket, the blades being slidably mounted in their respective forming pockets. The blade for forming pocket 3 is shown at 6.

1        A storage pocket 7 communicates with the upper end of  
2        forming pocket 3. It will be understood that there will  
3        be a similar storage pocket for each forming pocket.  
4        Storage pocket 7 contains a staple 8, as will all of the  
5        other storage pockets. An indexing mechanism is indi-  
6        cated at 9. In this diagrammatic representation, the  
7        indexing mechanism is illustrated as having a plunger-  
8        like element for each storage pocket. The plunger-like  
9        element of indexing mechanism 9 for storage pocket 7 is  
10       shown at 10.

11       To complete the structure, a vertical slot is shown  
12       at 11. The vertical slot 11 contains a safety 12 slid-  
13       ably mounted therein. There may be a vertical slot 11  
14       and safety 12 for each set of forming pockets and storage  
15       pockets. Alternatively, the slot 11 may run longitudi-  
16       nally throughout the length of cartridge assembly 1 with  
17       the safety 12 also extending the full length of the cart-  
18       ridge assembly 1. A window 13 may be provided, communica-  
19       ting with the lower end of slot 11.

20       Figure 1 illustrates the cartridge assembly 1 in its  
21       initial fully loaded condition. It will be understood  
22       that the cartridge assembly 1 will be mounted on a linear  
23       surgical stapling instrument (not shown). The operation  
24       of cartridge assembly 1 will be described in terms of  
25       forming pocket 3, storage pocket 7 and staples 4 and 8.  
26       It will be understood that precisely the same things will  
27       occur in all of the forming pockets and storage pockets.

28       When the linear surgical stapling instrument (not  
29       shown) is actuated for a first time, the driver 5 will be  
30       shifted downwardly to the position shown in Figure 2.  
31       This will drive staple 4 through tissue (not shown)  
32       located between the cartridge assembly 1 and anvil 2, and  
33       will cause the staple 4 to be formed by anvil 2. At the  
34       same time, the safety 12, which when in the position  
35       shown in Figure 1 precluded actuation of index mechanism

1 9, is shifted downwardly in slot 11 by driver 5.

5 After the first actuation of the linear surgical stapling instrument, the driver 5 is withdrawn to its normal retracted position. With the safety 12 located in the bottom of slot 11, the indexing mechanism 9 is free to be actuated, shoving staple 8 from storage pocket 7 into forming pocket 3, as illustrated in Figure 3. When the indexing mechanism 9 is returned to its normal retracted position, as shown in Figure 4, the staple 8 is free to be implanted and formed by a second actuation of the linear surgical stapling instrument, in the same manner described with respect to staple 4 in Figure 2.

10 The window 13 provides a visual indication to the surgeon that the cartridge assembly 1 is ready for the first actuation of the linear surgical stapling instrument or the second actuation of the linear surgical stapling instrument. This can be accomplished in several ways. The inside of slot 11 may be provided with one color and the safety with another. Similarly, the inside surface 15 of slot 11 may be provided with indicia viewable through window 13 and the safety 12 may be provided with additional indicia viewable through window 13. Both colors and indicia, viewable through window 13, can be used. The cartridge assembly 1 of Figures 1-4 constitutes a 20 simple example of a two-load cartridge assembly.

25 An exemplary multiple-load cartridge assembly is illustrated diagrammatically in Figures 5-8. In this instance, the cartridge assembly is generally indicated at 14 and is shown in cross-section through one side of the cartridge (i.e., one set of forming pockets and 30 storage pockets). A forming pocket is shown at 15 and its respective storage pocket is shown at 16. A driver 17, similar to driver 5 of Figure 1, is shown, together with its blade 18 for forming pocket 15. An indexing 35 mechanism 19, similar to indexing mechanism 9 of Figure 1

1 is shown, provided with its plunger-like portion 20 for  
storage pocket 16. The anvil of the linear surgical  
stapling instrument (not shown) to which cartridge  
assembly 14 is attached is indicated at 21.

5 Figure 5 illustrates the cartridge assembly 14 in its  
initial unfired condition. A staple 22 is located in  
forming pocket 15 and three additional staples 23, 24 and  
25 are located within storage pocket 16. Figure 6 illus-  
10 trates the cartridge assembly 14 after the linear surgi-  
cal stapling instrument (not shown) has been actuated for  
a first time. This results in driver 17 and its blade 18  
forcing surgical staple 22 through tissue (not shown)  
located between cartridge assembly 14 and anvil 21, and  
clinching the surgical staple 22 against anvil 21. It  
15 will be understood that all of the other staples (not  
shown) in all of the other forming pockets (not shown)  
will be similarly implanted and formed.

At the end of the first cycle of the linear surgical  
stapling instrument, the driver 17 will be returned to  
20 its normal retracted position, as shown in Figure 7. At  
this point, the indexing mechanism 19 will shift all of  
the next staples 23 in each of the storage pockets 16  
into their respective forming pockets 15. This is shown  
in Figure 8, wherein the first staple 23 of storage  
25 pocket 16 has been shifted into forming pocket 15. The  
linear surgical stapling instrument (not shown) can be  
actuated for a second time. This will result in implant-  
ing and forming or clinching of staple 23. This same  
procedure can be repeated through the implanting and  
30 clinching of staple 25, at which point the cartridge  
assembly 14 is empty and may be refilled or disposed of,  
depending upon whether it is a refillable and reusable  
cartridge assembly or a disposable cartridge assembly.

35 Figures 9-12 diagrammatically illustrate another  
embodiment of cartridge assembly similar to that shown in

1 Figures 5-8. Like parts have been given like index numerals. Cartridge assembly 14a differs from cartridge assembly 14 of Figures 5-8 only in that the storage pocket 16a lies at an angle to the forming pocket 15. The plunger-like portion 20a of indexing mechanism 19 is appropriately configured to advance staples 23-25 in the storage pocket 16a. It will appear from Figures 9-12 that the operation of cartridge assembly 14a is substantially identical to that described with respect to the cartridge assembly 14 of Figures 5-8. Figures 9-12 illustrate that variations can be made in the geometry and/or motions within the cartridge assembly of the present invention.

10 Another embodiment of the cartridge assembly of the present invention is diagrammatically illustrated in Figures 13-16. Again, it will be understood that the cartridge assembly, generally indicated at 26, will be attached to a linear surgical stapling instrument (not shown) having an anvil 27. Again, the views 13-16 are cross-sectional views through one side of the cartridge, illustrating one of a plurality of forming and storage pockets. The forming pocket is shown at 28. The storage pocket is shown at 29.

15 A driver 30, equivalent to driver 5 of Figure 1, is provided having a blade for each forming pocket. The blade for forming pocket 28 is shown at 31. A first indexing mechanism 32 is provided with a plunger-like portion for each storage pocket. The plunger-like portion for storage pocket 29 is shown at 33.

20 The embodiment of Figures 13-16 differs from the previously described multiple-load cartridge assemblies in that a staging pocket is provided between each storage pocket and forming pocket. The staging pocket between forming pocket 28 and storage pocket 29 is shown at 34.

25 The indexing mechanism 32 comprises a first indexing mechanism adapted to shift a staple from storage pocket

1 29 to staging pocket 34. A second indexing mechanism is  
provided and is indicated at 35. The purpose of the  
second indexing mechanism 35 is to shift a staple from  
the staging pocket 34 to forming pocket 28. As in the  
5 case of the first indexing mechanism 32, indexing mechanism  
35 will have a plunger-like portion 36 for each stag-  
ing pocket of the cartridge assembly 26.

10 It will be noted in Figure 13 that a first staple 37  
is located in forming pocket 28. Storage pocket 29 con-  
tains three additional staples 38, 39 and 40. Storage  
pocket 29 also contains a pusher 41 actuated by a compres-  
sion spring 42.

15 In Figure 13, the cartridge assembly 26 is shown in  
its initial, fully loaded condition. A first actuation  
of the linear surgical stapling instrument (not shown)  
will cause driver 30 to force staple 28 through tissue  
(not shown) located between the cartridge assembly 26 and  
the anvil 27 and to clinch staple 28 against anvil 27.  
At the same time, the first indexing mechanism 32 shifts  
20 the first staple 38 of storage pocket 29 into staging  
pocket 34. In fact, the first indexing mechanism 32  
could be actuated by driver 30. To this end, driver 30  
is shown in Figure 13 as having a lug (shown in broken  
lines) 30a overlying first indexing mechanism 32, which  
25 will actuate indexing mechanism 32 when driver 30 is  
actuated.

30 After the first actuation of the linear surgical  
stapling instrument, driver 30 is returned to its normal  
retracted position, as shown in Figure 15. At the same  
time, first indexing mechanism 32 is returned to its  
normal retracted position. This enables the pusher 41  
and coil spring 42 to shift the next surgical staple 39  
beneath the first indexing mechanism 32. At this stage,  
the second indexing mechanism 35 can be used to shift the  
35 second staple 38 from the staging pocket 34 to forming

1 pocket 28. Thereafter, the second indexing mechanism 35  
is returned to its normal position as shown in Figure 16  
and the cartridge assembly is ready for the next actua-  
tion of the linear surgical stapling instrument. This  
5 series of steps may be continued until the last staple 40  
of cartridge assembly 26 has been implanted and formed.

10 Another embodiment of the present invention is illus-  
trated in Figures 17-20. The embodiment of Figures 17-20  
is similar to that of Figures 13-16 and again demon-  
strates how variations in geometry and/or motions within  
the cartridge assembly can be made.

15 Turning first to Figure 17, the cartridge assembly is  
generally indicated at 43 and is intended to be affixed  
to a linear surgical stapling instrument (not shown)  
having an anvil 44. As in the case of the embodiment of  
Figures 13-16, the cartridge assembly 43 is provided with  
a plurality of forming pockets, staging pockets and stor-  
age pockets. In Figure 17, one set of these pockets is  
illustrated. The forming pocket is shown at 45. The  
20 staging pocket is indicated at 46 and the storage pocket  
is shown at 47. The cartridge assembly 43 is provided  
with a driver 48 having a blade for each forming pocket.  
The blade for forming pocket 45 is shown at 49. As in  
all of the embodiments, the cartridge assembly 43 aligns  
25 the driver with respect to anvil 44. An indexing mechan-  
ism 50 is provided having a plunger-like portion for each  
staging pocket. The plunger-like portion for staging  
pocket 46 is shown at 51. The indexing mechanism 50 is  
equivalent to indexing mechanism 35 of Figure 13. In  
30 Figure 17, a first staple is shown at 52 in forming  
pocket 45. A second staple is shown at 53 in staging  
pocket 46 and third and fourth staples are shown at 54  
and 55 in storage pocket 47.

35 In the embodiment of Figure 17, the storage pockets  
differ from those of the embodiment of Figure 13 in

1 several respects. First of all, the storage pocket 47 is  
2 oriented parallel to the blade 49 of driver 48. The  
3 surgical staples 54 and 55 are stacked in storage pocket  
4 47 one above the other. The storage pocket is provided  
5 with a pusher 56 actuated by a compression spring 57 and  
6 guided in guideways 58 and 59. Thus, pusher 56 and com-  
7 pression spring 57 automatically feed surgical staples  
8 from the storage pocket 47 to staging pocket 46 without  
9 the necessity of an additional indexing mechanism equiva-  
10 lent to indexing mechanism 32 of Figure 13.

11 Figure 17 illustrates the cartridge assembly 43 in  
12 its initial fully loaded condition, ready for the linear  
13 surgical stapling instrument (not shown) to be actuated  
14 for a first time. Upon actuation of the linear surgical  
15 stapling instrument, the driver 48 forces the staple 52  
16 in forming pocket 45 to pass through tissue (not shown),  
17 located between the cartridge assembly 43 and the anvil  
18 44, and to be clinched by the anvil 44. This is shown in  
19 Figure 18.

20 After the first actuation of the linear surgical  
21 stapling instrument, the driver 48 is returned to its  
22 initial retracted position and indexing mechanism 50 may  
23 be used to shift the second staple 53 from staging pocket  
24 46 into forming pocket 45. This is shown in Figure 19.  
25 Thereafter, the indexing mechanism 50 is returned to its  
26 normal position as shown in Figure 20 and the third  
27 staple 54 is shifted from storage pocket 47 to holding  
28 pocket 46 by pusher 56 and compression spring 57. The  
29 cartridge assembly 43 is now ready for a second actuation  
30 of the linear surgical stapling instrument. These  
sequential operations can be continued until the last  
staple 55 of cartridge assembly 43 has been formed and  
implanted.

31 In all of the embodiments of Figures 5-20, safety  
32 interlocks and load counting means have been omitted for

purposes of clarity. It will be understood, however, that such elements could and preferably would be provided with each embodiment. It will be understood by one skilled in the art that efficient design of the cartridge design would allow for single inputs from the surgeon via the linear surgical stapling instrument to result in several motions within the cartridge. For example, the forward stroke of the driver could not only form staples, but could also transfer staples from the storage pockets to the staging pockets, as described with respect to the embodiment of Figures 13-16. Similarly, the driver could be spring loaded so that it returns upon release, and in so doing, staples could be shifted from the storage pockets (or staging pockets if present) to the forming pockets. It could be within the scope of the invention to provide some form of stored energy source, such as a battery or compressed gas, to partially or fully operate the cartridge assembly.

As has been disclosed above, the geometry and/or the motions within the cartridge assembly can be widely varied. The use of staging pockets, as is evident from the above, is optional.

In all of the embodiments of Figures 1-20, the driver may or may not be a part of the multiple load cartridge assembly, as desired. Similarly, the anvil could be a part of the cartridge assembly, or not, as desired.

As indicated above, the cartridge assembly of the present invention may be permanent and refillable or it may be a single-use, disposable assembly. For purposes of a complete disclosure, the teachings of the present invention will now be described as applied to an actual linear surgical stapling instrument. While not intended to be so limited, for purposes of an exemplary showing the cartridge assembly of the present invention will be described in its application as a permanent part of a

1 disposable linear surgical stapling instrument of the type taught in the above-identified co-pending application. The teachings of this co-pending application are incorporated by reference herein, in their entirety.

5 A disposable linear surgical stapling instrument of the type contemplated is illustrated in Figure 21 and is generally indicated at 60. Briefly, the instrument 60 comprises a body 61 having a handle 62 and a trigger assembly 63. The instrument is provided at its forward 10 end with a fixed jaw 64, supporting an anvil 65. The instrument 60 is also provided with a movable jaw comprising the cartridge assembly of the present invention and generally indicated at 66. The movable jaw 66 is shiftably mounted on the body 61 and is operatively 15 connected to the handle and trigger assembly 62-63.

20 An adjustment bolt (not shown) is slidably mounted within the body 61 and is shiftable forwardly and rearwardly therein. An adjustment knob 67 is rotatably mounted at the rearward end of the body 61. The adjustment knob is operatively connected to the bolt to cause the bolt to shift forwardly and rearwardly within body 61.

25 When the adjustment bolt is shifted forwardly within the instrument body 61, by means of the adjustment knob 67, the bolt moves the handle and trigger assembly 62-63 forwardly and causes the movable jaw or cartridge assembly 66 to approach the fixed jaw 64. In other words, the cartridge assembly 66 approaches the anvil 65. A staple driver (not shown) is located in association with cartridge assembly 66 and is connected to and is shiftable by trigger 63 to drive staples from the cartridge assembly, through tissue (not shown) to be sutured (located between the cartridge assembly 66 and the anvil 65), and against the anvil 65. The anvil has a plurality of anvil pockets 30 (not shown) configured to clinch the staples over a range 35

1 of distances between the anvil 65 and the cartridge assembly 66, constituting the "working gap" of the instrument. The adjustment bolt also actuates indicator means 68 located on each side of the instrument 60, clearly showing when the working gap has been achieved between the anvil 65 and the cartridge assembly 66. The indicator means 68 is such that it will assist the surgeon in adjusting the distance between the anvil 65 and the cartridge assembly 66 within the working gap of instrument  
5 10 60.

An alignment pin 69 is shiftably mounted on the instrument body 61, extending through cartridge assembly 66. The alignment pin is manually shiftable by handle means 70 from its retracted position shown in Figure 21 to an operative position wherein it also extends into the fixed jaw 64. In this way, the alignment pin 69 not only assures that the anvil 65 and cartridge assembly 66 are properly oriented with respect to each other, but also traps the tissue (not shown) to be sutured between the anvil 65 and the cartridge assembly 66.  
15 20

Figure 22 is an exploded view of the cartridge assembly 66 of Figure 21. The cartridge assembly 66 is made up of a cartridge 71, a driver 107, first and second sliders 113 and 114, a support plate 126, an indexing button 162, a casing 140 and a safety 172. Each of these elements will be described in detail.  
25

The cartridge 71 is shown in Figures 23 through 32, wherein like parts have been given like index numerals. Cartridge 71 comprises an integral, one-piece molded plastic member comprising an elongated body 72, having a bottom 73 and an upstanding surrounding wall or flange 74 extending along its longitudinal edges and about its end 75. At its end 76, the wall 74 slopes downwardly to the bottom 73, as at 77 and 78.  
30 35

Along one of its longitudinal flights, the wall 74

1 has, on its inside surface, a plurality of integral, 5 inwardly extending cam members 79. In similar fashion, along the other of its longitudinal flights, the wall 74 has, on its inside surface, a second series of integral 10 cam members 80. As will be most apparent from Figures 24 and 29, the cam members 79 are substantially identical, as are the cam members 80. Additionally, the cam members 79 and 80 are substantially identical. It is to be noted, however, that the cam members 80 are staggered 15 with respect to the cam members 79 and, as a result, the cam members 80 are one less in number than the cam members 79.

15 The number of cam members 79 and 80 is not a limitation on the present invention. For convenience, the cam members 79 and 80 have been shown equal in number to the slots forming the storage and forming pockets described hereinafter.

20 Reference is made to Figure 29. It will be noted that each cam member 79 has a first planar surface 79a lying at an angle to wall 74 and extending away therefrom, a second surface 79b parallel to the inside surface of wall 74 and a third surface 79c extending from surface 79b to the inside surface of wall 74. Each cam member 80 25 has wall surfaces 80a, 80b and 80c, equivalent to the wall surfaces 79a through 79c of cam members 79. The purpose of cam members 79 and 80 will be apparent hereinafter.

30 Near the end 75 of cartridge 71, the bottom 73 has a perforation 81. The perforation 81 is adapted to accommodate alignment and retaining pin 69 (see Figure 21). Near its other end 76, the bottom 73 of cartridge 71 has an elongated slot 82. The slot 82 is adapted to accommodate the shank of the instrument pilot 82a (see Figure 45). The pilot 82a comprises a part of fixed jaw 64 and 35 has a shank lying at 90° to anvil 65 and passing through

cartridge 71 to render the cartridge captive and slidable with respect to instrument 60. The pilot 82a is fully described in the above noted co-pending application.

The outside surface of what has been termed, for convenience, the "bottom 73" of cartridge 71 is, in reality, the forwardmost surface of the cartridge assembly 66 and faces anvil 65 (see Figure 21). Near its end 75, the exterior surface of bottom 73 is provided with a forwardly extending spacer element 83 adjacent to perforation 81, as is shown in Figure 25. Similarly, the outside surface of bottom 73, near cartridge end 76, is provided with a forwardly extending spacer element 84 extending partway about the outermost end of slot 82. The spacers 83 and 84 cooperate with anvil 65 (see Figure 21) to determine the forwardmost position of cartridge assembly 66.

Referring now to Figure 26, cartridge 71 is provided with a centrally located, longitudinally extending, upstanding interior wall, generally indicated at 85. The wall 85 is provided with a plurality of vertical slots 86 which divide the wall 85 into alternating narrow upstanding elements 87 and wide upstanding elements 88. The endmost wide elements 88a and 88b are slightly narrower than the remaining wide elements 88 and are notched at 5 their outermost edges, as at 88c and 88d, as is shown in Figure 28.

Referring again to Figure 24, the interior wall 85 separates two rectilinear rows of slots 89 and 90. All of the slots 89 are identical, as are all of the slots 90. The slots 90 are mirror images of slots 89. It will be noted from Figure 24 that the slots 90 are staggered with respect to the slots 89 and, therefore, are one less in number. The number of slots 89 and 90 does not constitute a limitation of the present invention.

5 A typical slot 89 is illustrated in Figure 24a. The

1 slot 89 in the cartridge bottom 73 is defined by a recti-  
linear outer wall 89a, a pair of rectilinear end wall  
portions 89b and 89c, a pair of arcuate end wall portions  
89d and 89e, a pair of rectilinear end portions 89f and  
5 89g similar to end wall portions 89b and 89c, a pair of  
rectilinear inner wall portions 89h and 89i, parallel to  
outer wall 89a, a pair of rectilinear inner wall portions  
89j and 89k perpendicular to inner wall portions 89h and  
89i, and a final inner wall portion 89l.

10 End wall portions 89b and 89c are so spaced from each  
other that they will just nicely engage the legs of a  
surgical staple with a frictional fit. The same is true  
of rectilinear end wall portions 89f and 89g. As a  
result, that portion of slot 89, defined by outer wall  
15 89a and rectilinear end wall portions 89b and 89c, consti-  
tutes a storage pocket generally indicated at 91. A sur-  
gical staple is shown in storage pocket 91 in broken  
lines at 92. In a similar fashion, the rectilinear end  
wall portions 89f and 89g and the short rectilinear inner  
20 wall portions 89h and 89i constitute a forming pocket,  
the rectilinear end wall portions 89f and 89g being so  
spaced from each other as to just nicely engage the legs  
of a surgical staple with a frictional fit. The forming  
pocket portion of slot 89 is generally indicated at 93  
25 and a surgical staple is shown therein in broken lines at  
94. The storage pocket portion 91 of slot 89 is sepa-  
rated from forming pocket portion 93 by the shallow  
arcuate end wall portions 89d and 89e which are camming  
surfaces, as will be explained hereinafter. Inner wall  
30 portions 89j, 89k and 89m constitute or define an  
extended portion of slot 89 to accommodate a driver  
blade, as will be apparent hereinafter.

In Figure 36, the slots 89 have all of their wall  
portions 89a through 89m, together with their storage  
35 pockets 91 and its forming pockets 93 shown. Also,

1 staples 91a are illustrated in storage pockets 91 and  
staples 93a are shown in forming pockets 93. It will be  
apparent from Figure 36 that all slots 89 have an outer  
storage pocket provided with a surgical staple and an  
5 inner forming pocket also provided with a surgical  
staple. The same is true of all the slots 90, which are  
simple mirror images of the slots 89. Each slot 90 will  
have a storage pocket 94 equivalent to storage pocket 91  
and a forming pocket 95 equivalent to forming pocket 93.  
10 In each of the slots 90, a surgical staple 94a is shown  
in storage pocket 94 and a surgical staple 95a is shown  
in forming pocket 95.

Reference is now made to Figures 29, 30 and 31. As  
is most clearly seen in Figure 29, vertical reinforcing  
15 walls 98 extend perpendicularly from each portion of  
bottom wall 73 which separates the adjacent slots 89.  
Similarly, reinforcing walls 99 extend perpendicularly  
from those portions of cartridge bottom 73 which separate  
adjacent slots 90. As is apparent from Figures 24 and  
20 29, each interior wall portion 88 will have one reinforcing  
wall 98 and one reinforcing wall 99 constituting an  
integral part thereof. Depending upon its position, each  
interior wall portion 87 will have either one reinforcing  
wall 98 or one reinforcing wall 99 constituting an inte-  
25 gral part thereof. All of the reinforcing walls 98 are  
identical, as are all of the reinforcing walls 99. The  
reinforcing walls 99 are simple mirror images of reinforcing  
walls 98. The tops of all of the reinforcing walls  
98 and 99 are coplanar, as shown in Figure 30.

30 Referring to Figure 31, it will be apparent that each  
wall 99 comprises a wide portion 99a adjacent one of the  
inner wall portions 87 or 88, and portion 99a is of a  
width such that its side walls are coplanar with the end  
walls of each extension portion of adjacent slots 90.  
35 Thus, the portions 99a of reinforcing walls 99 serve as

1 additional guides for the blades of driver 72, to be  
described hereinafter. Each wall 99 has an additional  
portion 99b adjacent the portion 99a and of lesser width.  
This ensures that the wall 99 will not interfere with the  
5 forming pockets 95 of slots 90. It will be remembered  
that reinforcing walls 98 are a mirror image of reinforcing  
walls 99 and are thus similarly configured.

Reference is now made to Figures 23 and 24. To complete the cartridge 71, it should be noted that the wall  
10 74, at the cartridge end 75, has its interior surface so  
configured as to provide an end surface 100 substantially  
perpendicular to the long axis of interior wall 85. The  
end surface 100 terminates in a pair of parallel surfaces  
15 101 and 102, both perpendicular to end surface 100 and  
both terminating in shoulders 103 and 104, respectively.  
The purpose of the inner surfaces 100-104 of wall 74 will  
be apparent hereinafter. At the other end 76 of cartridge  
20 71, the interior surface of wall 74 is so configured  
as to provide a pair of shoulders or surfaces 105  
and 106. The purpose of these surfaces will be apparent  
hereinafter.

The driver 107 will next be described, and reference  
is made to Figures 33, 34 and 35. The driver 107 is an  
integral, one-piece element comprising an elongated body  
25 108, having at its ends hook-like elements 109 and 109a.  
Extending from body 108, there are a plurality of blades  
110, arranged in a rectilinear row. In similar fashion,  
additional blades 111 extend from body 108. The blades  
111 are also arranged in a rectilinear row. It will be  
30 noted that the blades 111 are staggered with respect to  
the blades 110 and, therefore, are one less in number.  
It will further be noted that the blades 110 are equal in  
number to the number of cartridge slots 89, while the  
blades 111 are equal in number to the number of cartridge  
35 slots 90.

As is most clearly shown in Figure 33, driver blades 110 and 111 are arranged in alternating groups of three. Starting at the left end of Figure 33, the first group comprises two blades 110 and one blade 111. The next group comprises two blades 111 and one blade 110, and so on. The blades of each group are joined together by webs 112 (see also Figure 35). As is evident from Figure 35, webs 112 are shorter than driver blades 110 and 111. Arranging the driver blades 110 and 111 in groups of three is a matter of convenience permitting cross bracing. Other groupings could be used. The webs 112 prevent spreading of driver blades 110 and 111 into the storage pockets 91 and 94.

Figure 36 is a simplified representation of the cartridge 71 and driver 107. In Figure 36, interior wall 85 of cartridge 71, together with cam elements 79 and 80 have been deleted for purposes of clarity. Figure 36 illustrates two groups of driver blades 110 and 111, and their connecting webs 112. It will be noted that the driver blades 110 are so positioned as to be centered over the staples 93a in forming pockets 93 of slots 89. Similarly, driver blades 111 are centered over the staples 95a in forming pockets 95 of slots 90. It will be appreciated from Figure 36 that when the driver is actuated, it will simultaneously drive the staples 93a and 95a from their respective forming pockets 93 and 95. Thus, two rows of staples, the staples of one row being staggered with respect to the other, will simultaneously be implanted in the tissue being sutured. It will be understood that the webs 112 extending between blades 110 and 111 will pass between the sections 87 and 88 of interior wall 85, through the slots 86 therebetween (see Figure 28).

As is most clearly shown in Figure 35, the free end of each driver blade 110 has a centrally located,

1 longitudinally extending slot 110a. Similarly, the free  
end of each driver blade 111 has a centrally located,  
longitudinally extending slot 111a. When the free ends  
5 of driver blades 110 and 111 contact their respective  
surgical staples 93a and 95a, the staple crowns will be  
engaged in the longitudinal slots 110a and 111a. As is  
most clearly shown in Figures 33 and 34, the longitudinal  
10 slots 110a of driver blade 110 are interrupted at their  
longitudinal centers by transverse notches 110b. Similarly,  
the longitudinal slots 111a of driver blade 111  
are interrupted at their longitudinal centers by trans-  
verse notches 111b. As is known in the art, the trans-  
15 verse notches 110b and 111b prevent staples from embed-  
ding in the driver blades 110 and 111 should they be  
over-formed.

Driver 107 is actuated by an elongated driver rod  
(not shown) located within the body 61 of instrument 60  
(see Figure 21). One end of the driver rod is opera-  
tively connected to trigger 63. The other end of the  
20 driver rod abuts the body 108 of driver 107 and is  
engaged by the hook-like portions 109 and 109a (Figure  
34), as described in the above noted co-pending applica-  
tion.

Figure 22 illustrates a pair of sliders 113 and 114.  
25 End views of sliders 113 and 114, as seen from the left  
in Figure 22, are shown in Figures 37 and 38. It will be  
evident from Figures 22 and 37 that slider 113 comprises  
an elongated member, the outside surface of which is pro-  
vided with a plurality of cam elements 115. The top sur-  
30 face 116 is planar, as is bottom surface 117. The inside  
surface 118 is also planar, oriented at 90° to bottom sur-  
face 117. Top surface 116 is joined to inside surface  
118 by a downwardly sloping surface 119. Slider 114 is  
similarly configured, having a plurality of cam surfaces  
35 120 on its outside surface, a planar top surface 121, a

1 planar bottom surface 122 and a planar inside surface 123  
oriented at 90° to bottom surface 122. As in the case of  
5 slider 113, the top surface 121 is joined to the inside  
surface 123 by a downwardly sloping surface 124. As is  
evident from Figures 22 and 45, sliders 113 and 114 are  
10 substantially mirror images of each other, with the exception  
that slider 114 has one less cam element than slider  
113, making their end configurations slightly different.  
Nevertheless, sliders 113 and 114 are sufficiently similar  
15 that a detailed description of one will suffice for  
the other. Reference is made to Figure 39 which is a  
simplified fragmentary view of cartridge 71 (its inner  
wall not shown) with slider 113 mounted therein.

In Figure 39, slider 113 is shown in its initial,  
15 normal position. It will be noted that the cam members  
115 of slider 113 are similar in configuration and nest  
with the cam members 79 of the inside surface of cartridge  
wall 74. Thus, each cam member has a surface 115a  
20 equivalent to surface 79a, a surface 115b substantially  
equivalent to that portion of the inside surface of wall  
74 between cam members 79 and a surface 115c equivalent  
to surface 79c. It will further be noted that the sur-  
faces just described are just slightly spaced from each  
25 other. Between cam elements 115, slider 113 has recti-  
linear surfaces 125 adapted to abut the surfaces 79b of  
cam elements 79. It will further be noted that the  
planar inner surface 118 of slider 113 lies adjacent the  
surgical staples 92 located in the storage pockets 91 of  
30 slots 89.

Figure 40 illustrates what happens when slider 113 is  
35 indexed in the direction of arrow A of Figure 39, such  
that each cam member 115 of slider 113 shifts to the  
other side of the next adjacent cam member 79 of cartridge  
wall 74. It will be apparent from Figure 39 that  
when slider 113 is shifted in the direction of arrow A,

1 cam surfaces 115a of the slider will contact and ride  
2 along corresponding cam surfaces 79a of the cartridge  
3 cams 79. Thus, slider 113 will not only move in the  
4 direction of arrow A in Figure 39, it will also shift  
5 inwardly toward the center of cartridge 71, to the posi-  
6 tion illustrated in Figure 40. This longitudinal and  
7 transverse movement of slider 113 will shift surgical  
8 staples 91a from the storage pockets 91 to the forming  
9 pockets 93 of slots 89. Thus, when the surgical staples  
10 93a, originally located in forming pockets 93 of slots  
11 89, have been implanted and clinched, the indexing of  
12 slider 113, as described with respect to Figures 39 and  
13 40, will shift staples 91a to forming pockets 93 so that  
14 the instrument 60 can be actuated for a second time. It  
15 will be apparent from Figure 39 that as the surgical  
16 staples 91a shift from storage pocket 91 to forming  
17 pocket 93, the legs of the staples 91a will have to bend  
18 slightly toward each other to enable them to shift past  
19 the arcuate end portions 89d and 89e of slots 89. When  
20 the forming pockets 93 are reached, the staples 91a will  
21 snap therein, being held by a frictional snap fit.

Slider 113 will remain in the position shown in  
Figure 40. It will be apparent that in this position the  
slider 113 will interfere with driver blades 110 (see  
Figure 36). However, as the driver blades 110 descend,  
they will first contact the beveled portion 119 of slider  
113 which will cause the slider to shift toward cartridge  
side 74 and its cam elements 79, out of the way of driver  
blades 110.

It will be understood by one skilled in the art that  
slider 114 operates in exactly the same manner to shift  
staples 94a from storage pockets 94 of slots 90 to the  
forming pockets 95 of the slots 90.

Support plate 126 is shown in Figures 22 and 41-44.  
The support plate comprises an elongated member made up

1 of side walls 127 and 128, together with end walls 129  
and 130. The side walls 127 and 128 narrow considerably  
at 127a and 128a, adjacent the end 129. This narrowing  
of the side walls creates a pair of shoulders 131 and  
5 132, the purpose of which will be described hereinafter.  
Side wall 127 has a pair of laterally extending lugs 133  
and 134. Similarly, side wall 128 has a pair of later-  
ally extending lugs 135 and 136. The purpose of lugs  
133-136 will also be apparent hereinafter.

10 The inside surface of side wall 127 and its narrow  
portion 127a has a plurality of inwardly extending lugs  
137 and 137a thereon. The lugs 137a, of which there are  
two, differ from lugs 137 only in that they extend above  
the top surface of side wall 127 and its narrow portion  
15 127a. In a similar fashion, the inside surface of side  
wall 128 and its narrow portion 128a has a plurality of  
lugs 138, 138a and 138b. The lugs 138a (of which there  
are two) differ from lugs 138 in that they also extend  
above the surface of side wall 128 and its narrow portion  
20 128a. The endmost lugs 138b (adjacent end walls 129 and  
130) are somewhat elongated as shown in Figure 41. To  
complete the structure, it will be noted that end wall  
130 is of lesser height than adjacent side walls 127 and  
128, creating a notch 139. The purpose of notch 139 will  
25 be described hereinafter.

Figure 45 illustrates the cartridge 71 with sliders  
113 and 114 mounted therein, together with support plate  
126. Mounting of the support plate is achieved by virtue  
30 of the fact that all of the lugs 137 and 137a of side  
wall 127 and its narrow portion 127a rest upon reinforce-  
ing walls 98 of the interior wall 85. Similarly, all of  
the lugs 138, 138a and 138b of support plate side wall  
128 and its narrow portion 128a rest upon support walls  
35 99 of the cartridge interior wall 85. End walls 129 and  
130 of support plate 126 rest in the notches 88c and 88d

1 of cartridge interior wall endmost members 88a and 88b, respectively. In addition, the exterior lugs 133 and 134 of side wall 127 rest upon selected ones of the cartridge cam elements 79. In a similar fashion, the exterior lugs 5 135 and 136 of the support plate side wall 128 rest upon selected ones of cartridge cam elements 80. As will be made apparent hereinafter, the primary purpose of support plate 126 is to serve as an interior reinforcing member for the cartridge assembly 66. It will be understood 10 that the blades 110 and 111 of driver 107 will extend through support plate 126.

The casing 140 is shown in Figures 22 and 46-51. The casing 140, in cooperation with cartridge 71, encloses the mechanism of the cartridge assembly 66. The casing 15 comprises a hollow, bottomless housing having substantially planar side walls 141 and 142, a substantially planar end wall 143 and an arcuate end wall 144. Side walls 141 and 142 and end walls 143 and 144 have upwardly and inwardly beveled portions 141a, 142a, 143a and 144a, respectively, terminating in the planar casing top 145.

The casing top 145 has a longitudinal slot 146 and a pair of transverse slots 147 and 148. The transverse slot 147 extends through the beveled portion 141a and the adjacent part of side 141. Similarly, the slot 148 extends through beveled portion 142a and the adjacent part of side wall 142. The purpose of slots 146, 147 and 148 is to accommodate the driver rod and handle plates (not shown) of the instrument. These elements are fully described in the above noted co-pending application. The 25 top 145 also has a perforation 149 which is coaxial with the perforation 81 of cartridge 71, and is also adapted to accommodate alignment and retaining pin 69.

The arcuate end wall 144 of casing 140 has a notch 150 adjacent the open end of casing 140. Side walls 141 and 142 have notches 151 and 152, respectively, adjacent 35

1 the open end of casing 140 and near notch 150. Notches  
150, 151 and 152 accommodate the indexing button of cartridge assembly 66, as will be described hereinafter.

5 Adjacent notch 151, the interior surface of side wall 141 has a cavity 153 formed therein. This is shown in Figures 50 and 51. That portion 141a of side wall 141 between notches 150 and 151 has the same thickness as the cavity portion 153. In a similar fashion, side wall 142 has a cavity 154 formed on its inside surface adjacent 10 notch 152. That portion 142a of side wall 142 between notches 150 and 152 is of the same thickness of the cavity portion 154. Cavity portions 153 and 154 serve to accommodate the indexing button of the cartridge assembly 66, as will be apparent hereinafter.

15 To complete the structure of casing 140, side wall 141 has a pair of shallow notches 155 and 156 adjacent the open end of casing 140. Similarly, side wall 142 has, formed on its inside surface, shallow notches 157 and 158 near the open end of casing 140. When the casing 20 140 is mounted on cartridge 71, the interior notches 155 and 156 of side wall 141 will receive portions of the lateral lugs 133 and 134, respectively, of support plate 126. Similarly, the interior notches 157 and 158 of side wall 142 will receive portions of the lateral lugs 135 25 and 136 of support plate 126. The free edges of side walls 141 and 142 will abut the walls 74 of cartridge 71. That edge of planar end wall 143 of casing 140 adjacent the open end of the casing will be received in the notch 130 at the end wall 139 of support plate 126. The abutting surfaces of the cartridge 71 and casing 140 can be 30 joined together by any appropriate means, such as adhesive means, sonic welding or the like. These abutting edges may be given a ship-lap configuration, if desired.

35 Turning briefly to Figure 63, casing 140 is shown mounted on cartridge 71. It will be noted that those

1 edges of casing sides 141 and 142 adjacent the open end  
of the casing are in abutment with the surrounding wall  
74 of cartridge 71. As indicated above, the engagement  
5 of these edges could be a ship-lap engagement, and they  
are joined together by any suitable means, such as adhe-  
sive, sonic welding or the like. Since the cartridge  
assembly is intended for use in a surgical environment,  
sonic welding is frequently preferred. Figure 63 also  
10 illustrates sliders 113 and 114, driver 107 and support  
plate 126.

The handle plates of the instrument 160, fully  
described in the above mentioned co-pending application,  
are fragmentarily shown in Figure 63 at 160 and 161.  
Handle plates 160 and 161 constitute part of the mech-  
15 anism by which a compressive force is applied to the tissue  
located between the cartridge assembly 66 and anvil 65,  
during achievement of the proper gap within the working  
gap of the instrument, prior to the suturing or stapling  
operation. One of the functions of support plate 126 is  
20 to transmit the force from handle plates 160 and 161 to  
the cartridge 71.

Referring to Figures 41-44, it will be remembered  
that the lugs 137a and 138a extend above the side walls  
of support plate 126. One pair of lugs 137a-138a is  
25 shown in broken lines in Figure 63. The function of  
these lugs is to maintain proper spacing between those  
portions of handle plates 160 and 161 within the cart-  
ridge assembly 66 to assure clearance between them and  
driver 107. The other pair of support plate upstanding  
30 lugs 137a and 138a, not shown in Figure 63, serve the  
same purpose.

Figure 63 also illustrates the lateral lugs 155 and  
157 of support plate 126, engaged in the notches 155 and  
157, respectively, of the casing side walls 141 and 142.  
35 It will be understood that support plate lugs 134 and 136

1 will similarly be engaged in casing notches 156 and 158,  
respectively. As a result of this, support plate 126  
contacts both the casing walls 141 and 142 and the  
surrounding wall 74 of cartridge 71. It will further be  
5 remembered that each of the support plate interior lugs  
137 and 137a abut and are supported by reinforcing walls  
98 while support plate lugs 138, 138a and 138b abut and  
are supported by reinforcing walls 99 (see Figure 45).  
Furthermore, each of the larger segments 88 has a rein-  
10 forcing wall 98 and a reinforcing wall 99 constituting an  
integral part thereof. Therefore, there is complete  
bracing transversely across the cartridge assembly 66  
against any transverse compressive forces. It will be  
noted from Figure 63 that the support plate 126 is  
15 located above sliders 113 and 114 and, therefore, cannot  
interfere with their operation.

Reference is now made to Figures 22 and 52-57,  
wherein indexing button 162 is illustrated. Indexing  
button 162 comprises a U-shaped member having an arcuate  
20 base portion 163 terminating in parallel leg portions 164  
and 165. Leg portion 164, itself, terminates in a thin  
leg portion 166, while leg portion 165 similarly termi-  
nates in a thin leg portion 167. Leg portions 166 and  
167 are also parallel and are coextensive.

25 On its exterior surface, the leg portion 166 carries  
an integral indicator 168 extending transversely thereof.  
The exterior surface of leg portion 167 carries an identi-  
cal indicator 169 extending transversely thereof and  
aligned with indicator 168.

30 To complete the structure of indexing button 162, leg  
portion 166 has an integral lug 170 extending downwardly  
from its inside surface. Leg portion 167 also has a lug  
171 extending downwardly from its inside surface. As is  
most clearly seen in Figures 55 and 56, the free ends of  
35 lugs 170 and 171 are enlarged so as to present abutment

1       surfaces 170a and 171a facing away from indexing button  
base portion 163. Abutment surfaces 170a and 171a are  
intended to contact the ends of sliders 113 and 114,  
respectively, so that the indexing button can be used to  
5       shift or index the sliders simultaneously. It will be  
noted from Figures 52-55 that the lug 70 is of a lesser  
transverse length than the lug 171. This takes into  
account the difference in lengths of the sliders 113 and  
114.

10       Figures 58, 59 and 63 illustrate indexing button 162  
mounted in cartridge assembly 66. In all of these Fig-  
ures, the indexing button is shown in its normal, unactu-  
ated position. It will be noted that the base portion  
163 and the majority of leg portions 164 and 165 extend  
15       beyond the confines of cartridge 71 and casing 140  
through the notch 150 in the rounded end 144 of casing  
140. Thin leg portions 167 and 166 of indexing button  
162 are supported by cartridge cam elements 80 and 79,  
respectively. Downwardly depending lug 170 lies along  
20       the inside surface portion 101 of cartridge wall 74 (see  
also Figure 24). Similarly, the downwardly depending lug  
171 of indexing button 162 lies along the inside surface  
portion 102 of cartridge wall 74. The indexing button  
lugs 170 and 171 also abut the inside surface portion 100  
25       of cartridge wall 74. Since indexing button 162 is sub-  
stantially U-shaped, it will be understood that it will  
not interfere with cartridge perforation 81 or alignment  
and retaining pin 69 extending therethrough. The abut-  
ment surfaces 170a and 171a are located adjacent the ends  
30       of sliders 113 and 114, respectively.

35       The large notch 151 of casing side 141 serves as a  
window through which indexing button indicator 168 can be  
easily viewed. Similarly, the large notch 162 in the  
casing side 142 serves as a window through which indexing  
button indicator 169 can be viewed. Either the casing

140 or the cartridge 71 can be provided with indicia cooperating with indexing button indicators 168 and 169. For purposes of an exemplary showing, the cartridge portion of cartridge assembly 66 is shown (in Figure 21) provided with the numerals "1" and "2". As shown in Figure 21, when the indexing button 162 is in its normal, unactuated position, its indicator 169 will align with the numeral "1" on the cartridge. The same sort of indicia may be provided on the other side of the cartridge to cooperate with indicator 168.

It will be apparent from Figures 58, 59 and 63 that if indexing button 162 were shifted in the direction of arrow B in Figure 59, the abutment surfaces 170a and 171a would engage the ends of sliders 113 and 114, causing them to index as described above. As will be apparent from Figure 45, when sliders 113 and 114 are indexed, the ends opposite those ends contacted by abutment surfaces 170a and 171a of indexing button 162 will abut the inside surface portions 105 and 106 of cartridge wall 74 to prevent over-indexing. Furthermore, support plate shoulders 131 and 132 act as stop surfaces for indexing button 162. Returning to Figure 21, once indexed, the indicator 169 will align with the numeral "2" on cartridge 71, the same being true of indexing button indicator 168. This is a clear visual indication to the surgeon that the second load of staples has been shifted from the storage pockets to the forming pockets of cartridge 71 and are ready for implanting and forming by a second actuation of instrument 60.

The cartridge assembly 66 is completed by safety 172 illustrated in Figures 22 and 60-62. The purpose of safety 172 is to prevent indexing of indexing button 102 and sliders 113 and 114 when staples are still present in forming pockets 93 and 95. In this way, proper sequencing of the cartridge assembly 66 is assured and jamming

1 is precluded.

5 The safety 172 comprises an elongated shank 173 of uniform width and thickness terminating at its upper end, as viewed in Figures 61 and 62 in an enlarged portion 174. At its lower end, the shank 173 terminates in an enlarged portion 175, somewhat larger than the enlarged end 174. The enlarged end 175 provides an abutment surface 176 intended to cooperate with the abutment surface 171a of lug 171 on indexing button 162.

10 Safety 172 is shown in its normal position within cartridge assembly 66 in Figure 63. It will be noted that the shank portion 173 extends through the support plate 126 at the juncture of end wall 129 and lug 138b of narrow side wall portion 128a (see also Figure 41). The 15 enlarged end 175 is located just beneath support plate 126 while the enlarged end 174 is located beneath a shoulder 107a of driver 107 (see also Figures 34 and 35). When safety 172 occupies the position shown in Figure 63, its abutment surface 176 faces abutment surface 171a of 20 indexing button 162 and precludes movement thereof.

25 The bottom 73 of cartridge 71 is provided with a perforation 177 so sized as to just nicely receive the enlarged end 175 of safety 172. It will be apparent from Figure 63 that when the instrument is actuated for a first time, causing driver 107 to shift downwardly and to implant and form the staples 93a and 95a in forming pockets 93 and 95, the shoulder 107a of driver 107 will contact the uppermost surface of the enlarged safety end 174, causing the safety 172 to shift downwardly. This 30 will cause the enlarged end 175 of the safety 172 to enter the perforation 177 in cartridge 71, clearing the way for indexing of indexing button 162 and sliders 113 and 114, as soon as driver 107 is returned to its normal retracted position. The downwardmost position of safety 35 172 is determined by the abutment of its upper enlarged

end 174 against the top surface of support plate 126.

The cartridge assembly 66 of the present invention, having been described in detail, its operation may now be set forth. In the particular embodiment shown, the cartridge assembly 66 comprises a permanent part of instrument 60. When the surgeon receives instrument 60, it will be in the condition shown in Figure 21 with the cartridge assembly 66 spaced from anvil 65 and the alignment and retaining pin 69 in its retracted position. The surgeon locates the tissue to be sutured between the cartridge assembly 66 and the anvil 65, and then shifts the alignment and retaining pin 69 to its operating position by handle 70. In this position, the alignment and retaining pins 69 extends through the cartridge assembly 66 and into a suitable perforation in fixed jaw 64, trapping the tissue to be sutured between anvil 65 and cartridge assembly 66.

This having been accomplished, the surgeon next sets the gap or distance between the cartridge assembly 66 and the anvil 65, within the working gap of the instrument, in accordance with the procedures set forth in the above noted co-pending application. Thereafter, trigger 63 is actuated, causing driver 107 to shift the staples 93a and 95a in forming pockets 93 and 95 through the tissue and against the anvil 65, thus implanting and clinching these staples to form a double, staggered row of staple sutures. This having been done, the cartridge assembly 66 is shifted to its retracted position, as is alignment and retaining pin 69, and the instrument is removed from the sutured tissue.

As indicated above, the first actuation of driver 107 will simultaneously shift cartridge assembly safety 172 from its disabling to its enabling position. The surgeon is now free to push indexing button 162 with respect to assembly 166, thus indexing sliders 113 and 114 and

1 shifting surgical staples 91a and 94a from holding  
pockets 91 and 94 to forming pockets 93 and 95. Indexing  
button indicators 168 and 169 will show that this has  
been done and that the instrument is ready for a second  
5 use. At this point, the stapling procedure just  
described can be repeated. After the second actuation of  
the instrument 60, the instrument, together with the cart-  
ridge assembly 66, is disposed of.

10 While the cartridge assembly 66 may be appropriately  
constructed for refilling and reuse, it lends itself well  
to manufacture as a single-use, disposable unit. The  
various parts illustrated in Figure 22 can be molded of  
plastic material suitable for a surgical environment and  
capable of being sterilized by autoclave, ethylene oxide,  
15 irradiation, or other standard methods.

15 In the embodiments thus far described, when the surgical  
staples in the forming pockets have been formed and  
implanted, at least a second set of staples is introduced  
into the forming pockets directly from storage pockets,  
20 or from staging pockets located between the forming  
pockets and the storage pockets. It is within the scope  
of the invention to provide an embodiment of the cart-  
ridge assembly wherein, after the first set of staples in  
the forming pockets have been implanted and formed, the  
25 forming pockets are moved from the line of action between  
the driver and the anvil, and the storage pockets, con-  
taining a second set of surgical staples, are shifted  
into the line of action between the driver and the anvil,  
thus becoming forming pockets. This arrangement is illus-  
30 trated in simplified, diagrammatic form in Figures 65-68.

35 Reference is first made to Figure 65, wherein a cart-  
ridge assembly is generally indicated at 178. The anvil  
of a linear surgical stapling instrument is diagrammati-  
cally indicated at 179. The magazine assembly 178 com-  
prises a body 180 and a plunger-like element 181

1 shiftable transversely with respect to body 180. The  
plunger-like element 181 contains a row of forming  
pockets, the endmost one of which is shown at 182. The  
plunger-like element 181 contains a row of storage  
5 pockets, the endmost one of which is shown at 183. Each  
of the forming pockets and each of the storage pockets is  
provided with a surgical staple. A surgical staple 184  
is shown in endmost forming pocket 182 and a surgical  
staple 185 is shown in endmost storage pocket 183. The  
10 number of storage pockets is equal to the number of  
forming pockets.

The cartridge assembly 178 has a driver 186. The  
driver 186 is provided with a plurality of blades equal  
in number to the number of forming pockets. The endmost  
15 driver blade is shown at 187. The body 180 has a slot  
for each driver blade. The endmost slot for driver blade  
187 is shown at 188. To complete the diagrammatic repre-  
sentation of Figure 65, the plunger-like element 181 is  
provided with a handle-like element 189, representing an  
20 indexing mechanism.

Figure 65 illustrates the cartridge assembly 178 in  
its initial, fully loaded condition. It will be under-  
stood that the cartridge assembly 178 will be mounted on  
a linear surgical stapling instrument (not shown). The  
25 operation of the cartridge assembly 178 will be described  
in terms of forming pocket 182, storage pocket 183 and  
staples 184 and 185. It will be understood that pre-  
cisely the same things will occur in all of the forming  
pockets and storage pockets.

30 When the linear surgical stapling instrument (not  
shown) is actuated for a first time, the driver 186 will  
shift downwardly as viewed in Figure 65 to the position  
shown in Figure 66. This will drive the staple 184 from  
forming pocket 182, through tissue (not shown) located  
35 between the cartridge assembly 178 and the anvil 179, and

1 will cause the staple 184 to be formed by anvil 179.

After the first actuation of the linear surgical stapling instrument, the driver 186 is withdrawn to its normal retracted position, as shown in Figure 67. At 5 this point, the indexing mechanism 189 is used to shove the plunger-like element 181 to the left as viewed in Figures 65-68, to the position shown in Figure 67. This movement of the plunger-like member 181 shifts the forming pocket 182 from the line of action between driver 186 10 and anvil 179. This, of course, is true of all of the forming pockets. Simultaneously, storage pocket 183 (and all of the other storage pockets) are shifted into the line of action between the driver 186 and anvil 179. This is illustrated in Figure 67. It will be seen from 15 Figure 67 that with the plunger-like element 181 in the position shown, the storage pocket 183 (and the other storage pockets), in essence, become or are converted to forming pockets.

At this point, the linear surgical stapling instrument 20 can be actuated for a second time. This will cause staple 185 of pocket 183 to be driven from pocket 183 (and all of the other staples to be driven from the equivalent pockets), through tissue (not shown) between the cartridge assembly 178 and the anvil 179, and to be 25 clinched by the anvil 179. This is shown in Figure 68.

The cartridge assembly 178 of Figures 65-68 constitutes a simple example of a two-load cartridge assembly. It will be understood that the plunger-like element 181 30 could be provided with additional rows of storage pockets, each row (in its turn) being shiftable into the line of action between driver 186 and anvil 179.

In the embodiment just described, the forming pocket 182 (and the other forming pockets therebehind) and the storage pocket 183 (and the other storage pockets there- 35 behind) are shifted in a rectilinear path of travel. It

1 will be understood that other paths of travel could be  
used. To illustrate this, reference is made to the  
embodiment of Figure 69.

5 In Figure 69, a cartridge assembly is generally  
indicated at 190, together with an anvil 191. The cartridge  
assembly 190 comprises a body 192 and a member 193  
rotatable with respect thereto. The member 193 is pro-  
vided with a row of forming pockets, the endmost one of  
10 which is shown at 194. The member 193 is provided with  
one or more rows of storage pockets. For purposes of an  
exemplary showing, the member 193 is shown as having two  
rows of storage pockets, the endmost storage pocket of  
each row being shown at 195 and 196, respectively. Each  
15 forming pocket and each storage pocket is provided with a  
surgical staple. To this end, forming pocket 194 is  
shown provided with a surgical staple 197. Storage  
pockets 195 and 196 are shown provided with surgical  
staples 198 and 199, respectively. Again, it will be  
understood that the number of storage pockets in each row  
20 thereof will be equal and will be equal to the number of  
forming pockets.

25 A driver is illustrated at 200. The driver will have  
a blade for each forming pocket. The endmost blade of  
driver 200 is shown at 201. The body 192 of cartridge  
assembly 190 will have slots formed therein equal in  
number to the driver blades and adapted to slidably  
receive the driver blades. The endmost slot of body 192  
is indicated at 202. Finally, to complete the cartridge  
assembly 190 of Figure 69, the member 193 is shown as  
30 having a handle-like element 203, diagrammatically repre-  
senting an indexing means.

35 Again, it will be understood that the cartridge assem-  
bly 190 will be affixed to an appropriate linear surgical  
stapling instrument (not shown). In Figure 69, the cart-  
ridge assembly is illustrated in its initial, fully

1 loaded condition. Upon a first actuation of the linear  
surgical stapling instrument, the driver 200 will shift  
the staple 197 of forming pocket 194 out of forming  
pocket 194, through tissue (not shown) located between  
5 the cartridge assembly 190 and the anvil 191, and will  
cause the clinching of staple 197 by anvil 191. It will  
be understood that surgical staples located in the other  
forming pockets (not shown) will be similarly implanted  
and formed.

10 Thereafter, the driver 200 is returned to its normal  
position illustrated in Figure 69 and the indexing ele-  
ment 203 may be used to rotate member 193 so that the row  
of forming pockets represented by forming pocket 194 will  
be shifted out of the line of action between driver 200  
15 and anvil 191, and the row of storage pockets, repre-  
sented by storage pocket 195, will be shifted into the  
line of action between driver 200 and anvil 191, becoming  
the equivalent of forming pockets. The linear surgical  
stapling instrument (not shown) can now be actuated for a  
20 second time, and the driver 200 will cause the row of  
staples represented by staple 198 to be shifted from  
storage pockets represented by storage pocket 195 through  
tissue (not shown) located between cartridge assembly 190  
and anvil 191, and to be clinched or formed by the anvil  
25 191.

At this stage, the driver 200 can again be returned  
to its normal position shown in Figure 69 and the index-  
ing element 203 can be used to cause the member 193 to  
rotate again, shifting the row of storage pockets repre-  
30 sented by storage pocket 195 out of the line of action  
between driver 200 and anvil 191 and locating the storage  
pockets represented by storage pocket 196 within this  
line of action. The storage pockets represented by stor-  
age pocket 196 thus become the equivalent of forming  
35 pockets.

1       At this point, the surgical stapling instrument can  
again be actuated. This will result in the driver 200  
shifting the staples represented by staple 199 from the  
storage pockets represented by storage pocket 196,  
5       through tissue (not shown) located between the cartridge  
assembly 190 and anvil 191, causing these staples to be  
clinched or formed by the anvil 191.

In the embodiment of Figure 69, as is true of the  
embodiment of Figures 65-68, the number of rows of stor-  
10     age pockets does not constitute a limitation. In the  
embodiment of Figures 65-68 and the embodiment of Figure  
69, safety interlocks and load counting means have been  
omitted for purposes of clarity. It will be understood  
15     that such elements could, and preferably would, be pro-  
vided with each embodiment. Both embodiments could con-  
stitute disposable cartridge assemblies, reusable and  
refillable cartridge assemblies, or could be incorporated  
into a completely disposable instrument. As was  
described with respect to the embodiments of Figures  
20     5-20, efficient design of the cartridge assemblies would  
allow for single inputs from the surgeon via the linear  
surgical stapling instrument to result in several motions  
within the cartridge. Again, some form of stored energy  
source could be associated with the cartridge assemblies  
25     to partially or fully operate them. In all of the embodi-  
ments of Figures 1-20 and Figures 65-69, the driver, or  
the anvil, or both, could constitute a part of the mul-  
tiple load cartridge assembly, itself.

In the above description, terms such as "top",  
30     "bottom", "upper", and "lower", are used in conjunction  
with the drawings for purposes of clarity. One skilled  
in the art will understand that during use, the instru-  
ment 60 may assume any desired or required orientation.

Modifications may be made in the invention without  
35     departing from the spirit thereof.

## 1       WHAT IS CLAIMED IS:

1. A surgical stapling instrument for implanting staples in tissue, comprising:

5       anvil means;

means for driving staples against said anvil means;

a first array of staples located in a first position within said instrument aligned between said driving means and said anvil means;

10       a second array of staples located in a second position within said instrument out of alignment with said driving means and said anvil means;

15       means for actuating said driving means to move an array of staples from said first position and clinch said array of staples against said anvil means; and

means for transferring said second array of staples from said second position to said first position after a first operation of said actuating means to enable a second operation of said actuating means.

20       2. The instrument of claim 1, further comprising first storage means for storing an array of staples at said first position and second storage means for storing an array of staples at said second position.

25       3. The instrument of claim 1, wherein said transfer means comprises means for individually shifting each of the staples contained in said second array from said second position to said first position.

30       4. The instrument of claim 2, wherein said transfer means includes means for indexing said first storage means out of said first position while indexing said second storage means from said second position to said first position.

35       5. The instrument of claim 2, wherein said first storage means comprises a plurality of forming pockets and said second storage means comprises a plurality of

1 storage pockets.

6. The instrument of claim 5, wherein each of said storage pockets corresponds to a forming pocket and is located adjacent thereto.

5 7. The instrument of claim 6, wherein said first array of staples includes one staple in each of said forming pockets and said second array of staples includes at least one staple in each of said storage pockets.

10 8. The instrument of claim 7, wherein said transfer means includes means for indexing a staple from each of said storage pockets to its corresponding forming pocket after each operation of said actuating means.

15 9. The instrument of claim 1, further comprising safety means for preventing a second operation of said actuating means before operation of said transfer means.

10. The instrument of claim 5, wherein said forming pockets are arranged in at least two rows which are longitudinally staggered.

11. The instrument of claim 4, further including 20 third storage means for storing a third array of staples at a third position, and fourth storage means for storing a fourth array of staples at a fourth position.

12. The instrument of claim 11, wherein said transfer means further includes means to ultimately index each 25 of said storage means to said first position.

13. The instrument of claim 12, further including means for indicating which of said storage means is in said first position.

14. The instrument of claim 1, including means for 30 indicating which of said array of staples is positioned in said first position.

15. A surgical stapling instrument for simultaneously implanting a plurality of staples in tissue, comprising:

35 anvil means;

1                   means for driving staples against said anvil  
means;

5                   first cartridge means for holding a plurality of  
staples in a first position aligned between said driving  
means and said anvil means;

10                  second cartridge means for holding a plurality  
of staples in a second position out of alignment with  
said driving means and said anvil means;

15                  means for actuating said driving means to move  
said staples from said first cartridge means and clinch  
said staples against said anvil means; and

20                  means for indexing said second cartridge means  
from said second position to said first position, after a  
first operation of said actuating means, to enable a  
second operation of said actuating means.

25                  16. The instrument of claim 15, wherein said first  
and second cartridge means are contained within a unitary  
cartridge assembly.

30                  17. The instrument of claim 16, wherein said cart-  
ridge assembly is removably mounted on said instrument.

35                  18. The instrument of claim 16, wherein said instru-  
ment comprises a disposable instrument.

40                  19. The instrument of claim 17, wherein said cart-  
ridge assembly is disposable.

45                  20. The instrument of claim 17, wherein said cart-  
ridge assembly may be removed from said instrument,  
refilled with staples and replaced in said instrument,  
allowing said cartridge assembly to be reused.

50                  21. The instrument of claim 15, further including  
means for indicating which of said cartridge means is  
located at said first position.

55                  22. A surgical stapling instrument for forming and  
implanting at least one row of surgical staples in  
tissue, comprising:

60                    35                  a frame terminating at its forward end in a

1      fixed jaw;  
      an anvil mounted on said fixed jaw;  
      a cartridge assembly, slidably supported by said  
      frame and shiftable longitudinally thereon, containing at  
5      least one row of forming pockets, each of which contains  
      a staple, and a plurality of staple-carrying staging pock-  
      ets, each of which is coupled to a corresponding forming  
      pocket;  
      means slidably mounted within said cartridge  
10     assembly for driving said staples from said forming pock-  
      ets against said anvil;  
      means for actuating said staple driving means  
      between a retracted position and a staple driving posi-  
      tion; and  
15     means for transferring a staple from each of  
      said staging pockets to its corresponding forming pocket  
      after a first operation of said actuating means, to  
      enable another operation of said actuating means.

20     23. The instrument of claim 22, wherein said cart-  
      ridge means further includes a plurality of storage pock-  
      ets, coupled to each of said staging pockets, for storing  
      at least one staple in each pocket thereof.

25     24. The instrument of claim 23, further including  
      second transfer means for moving a staple from each of  
      said storage pockets to its corresponding staging pocket  
      upon operation of said first transfer means.

30     25. The instrument of claim 22, wherein said anvil,  
      said staple driving means and said cartridge assembly  
      comprise a disposable unit which is removably mounted on  
      said frame.

35     26. The instrument of claim 22, wherein said cart-  
      ridge assembly is removably mounted on said frame, and  
      said pockets thereof are capable of being refilled with  
      staples.

35     27. The instrument of claim 22, wherein said forming

1      Pockets are arranged in at least two rows which are longitudinally staggered.

28. The instrument of claim 24, wherein said first and second transfer means operate simultaneously.

5      29. The instrument of claim 22, further comprising safety means for preventing operation of said indexing means when staples are present in said forming pockets.

10     30. The instrument of claim 22, wherein said anvil and said cartridge assembly comprise a disposable unit which is removably mounted on said frame.

15     31. The instrument of claim 22, further comprising means for indicating that said transfer means has operated.

32. A linear surgical stapling instrument for simultaneously forming and implanting at least one row of surgical staples in tissue, comprising:

anvil means;

means for driving staples against said anvil means;

20     cartridge means for holding a plurality of staples, said cartridge means containing a first set of pockets aligned between said driving means and said anvil means and a second set of pockets coupled to each of said first pockets, wherein each of said pockets contains a staple;

means for actuating said driving means to move said staples from said first set of pockets of said cartridge means and clinch said staples against said anvil means; and

30     means for transferring said staples from said second set of pockets to said first set of pockets, after a first operation of said actuating means, to enable a second operation of said actuating means.

33. The instrument of claim 32, wherein said first set of pockets is arranged in at least two staggered

1. rows.

34. The instrument of claim 32, wherein said cartridge means comprises a disposable unit which is removably mounted on said instrument.

5 35. A multiple load cartridge for use in a surgical stapling instrument having anvil means for simultaneously implanting a plurality of surgical staples in tissue, comprising:

means for driving staples against said anvil  
10 means;

cartridge means for holding a plurality of staples, said cartridge means containing a first set of pockets aligned between said driving means and said anvil means and a second set of pockets corresponding to each 15 of said first pockets, wherein each of said pockets contains a staple;

means for actuating said driving means to move said staples from said first set of pockets and clinch said staples against said anvil means to implant said 20 staples in tissue;

first means for indexing said first set of pockets out of alignment with said driving means and said anvil means; and

25 second means for indexing said second set of pockets into alignment between said driving means and said anvil means, after operation of said actuating means and said first indexing means, whereby a second operation of said actuating means is enabled.

36. The assembly of claim 35, wherein said driving means and said cartridge means are contained in a unitary cartridge assembly which is removably mounted on said surgical stapling instrument.

37. The assembly of claim 36, wherein said unitary cartridge assembly is disposable.

35 38. The assembly of claim 36, wherein said unitary

1      cartridge assembly comprises a reusable unit which may be  
refilled with staples.

5      39. A multiple-load cartridge assembly for use with  
a linear surgical stapling instrument of the type having  
an anvil and a staple driver actuator which, when actu-  
ated, simultaneously implants at least one row of surgi-  
cal staples in the tissue of a patient and clinches said  
surgical staples of said at least one row against said  
anvil, said cartridge assembly comprising a cartridge  
10     having at least one row of staple-containing forming  
pockets, a driver mounted within said cartridge assembly  
and shiftable therein by said driver actuator between a  
retracted position and an extended position, said driver  
having a plurality of blades equal in number to the num-  
15     ber of said forming pockets and configured to enter said  
forming pockets and drive said staples therein through  
said tissue and against said anvil when shifted from said  
retracted position to said extended position by operation  
of said staple driver actuator, said cartridge assembly  
20     having a plurality of storage pockets equal in number to  
said forming pockets and each containing at least one  
staple and an indexing means to shift said at least one  
staple in each storage pocket to the adjacent one of said  
forming pockets to reload said forming pockets after the  
25     first operation of said staple driver actuator.

40. The cartridge assembly claimed in claim 39,  
including a safety means to disable said indexing means  
until said forming pockets are emptied by said driver.

41. The cartridge assembly claimed in claim 39,  
30     having at least two staggered rows of staple-containing  
forming pockets and a staple-containing storage pocket  
for each of said forming pockets.

42. The cartridge assembly claimed in claim 39,  
including visual indicator means showing the number of  
35     the load of surgical staples in said forming pockets.

1       43. The cartridge assembly claimed in claim 39, including an equal number of surgical staples, greater than one, in each of said storage pockets, and including a staging pocket between each storage pocket and its  
5       respective forming pocket, said indexing means comprising a first indexer to shift a staple from each storage pocket to its respective staging pocket when empty and a second indexer to shift a staple from each staging pocket to its respective forming pocket to reload said forming pocket after each operation of said driver actuator.  
10

15       44. The structure claimed in claim 39, including an equal number of surgical staples, greater than one, in each of said storage pockets, said indexing means being capable of shifting a staple from each of said storage pockets to its respective forming pocket after each operation of said driver actuator to introduce a staple load into said forming pockets.

20       45. The structure claimed in claim 41, including an equal number of surgical staples, greater than one, in each of said storage pockets, said indexing means being capable of shifting a staple from each of said storage pockets to its respective forming pocket after each operation of said driver actuator to introduce a staple load into said forming pockets.  
25

30       46. A multiple load cartridge assembly for use with a linear surgical stapling instrument of the type having an anvil and a staple driver actuator which, when actuated, simultaneously implants at least one row of surgical staples in the tissue of a patient and clinches said surgical staples of said at least one row against said anvil, said cartridge assembly comprising a driver mounted within said cartridge assembly and shiftable therein by said driver actuator between a retracted position and an extended position, a cartridge having at  
35       least one row of staple-containing first pockets at a

1    first position aligned between said driver and said  
anvil, said driver having a plurality of blades equal in  
number to the number of said first pockets and configured  
to enter said first pockets and drive said staples  
5    therein through said tissue and against said anvil when  
shifted from said retracted position to said extended  
position by operation of said staple driver actuator,  
said cartridge assembly having a plurality of second  
pockets at a second position equal in number to said  
10   first pockets and each containing at least one staple,  
and indexing means to shift said plurality of first pock-  
ets out of said first position and said plurality of said  
second pockets into said first position after the first  
operation of said staple driver actuator to enable a  
15   second operation of said actuator.

47. The cartridge assembly claimed in claim 46,  
including a safety means to disable said indexing means  
until said first pockets are emptied by said driver.

48. A method of applying a plurality of surgical  
20   staples to tissue with a surgical stapling instrument of  
the type having a fixed jaw supporting an anvil, a mov-  
able jaw, a multiple load staple cartridge coupled to  
said movable jaw, a staple driver, and means for actua-  
ting said staple driver, comprising the steps of:

25       (a) positioning said tissue to be stapled  
between said anvil and said staple cartridge located on  
said movable jaw, said cartridge containing a first array  
of staples located in a first position within said cart-  
ridge aligned between said anvil and said driver, and a  
30   second array of staples located in a second position  
within said cartridge out of alignment with said anvil  
and said staple driver;

35       (b) adjusting said movable jaw toward said  
anvil so that said cartridge is spaced at a distance from  
said anvil such that said staples will be properly

clinched against said anvil;

(c) operating said staple driver to drive said first array of staples from said first position in said cartridge through said tissue and against said anvil;

(d) adjusting said movable jaw away from said stapled tissue;

(e) releasing said stapled tissue from between said jaws of said instrument;

(f) operating an indexing means to transfer said second array of staples from said second position to said first position;

(g) repeating steps (a) through (e).

49. The method of claim 48, wherein the indexing step further includes the step of individually shifting each of said staples contained in said second array from said second position to said first position.

50. The method of claim 48, wherein the indexing step further includes the step of simultaneously shifting all of said staples contained in said second array from said second position to said first position.

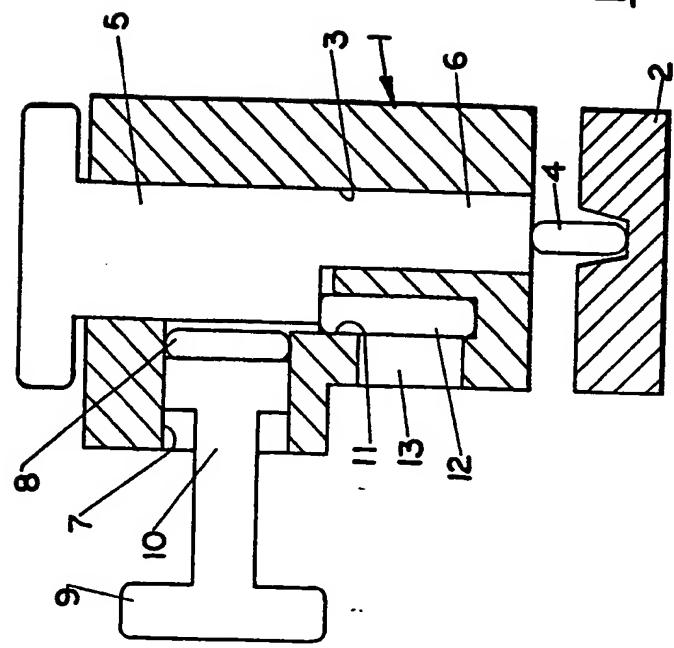


FIG. 2

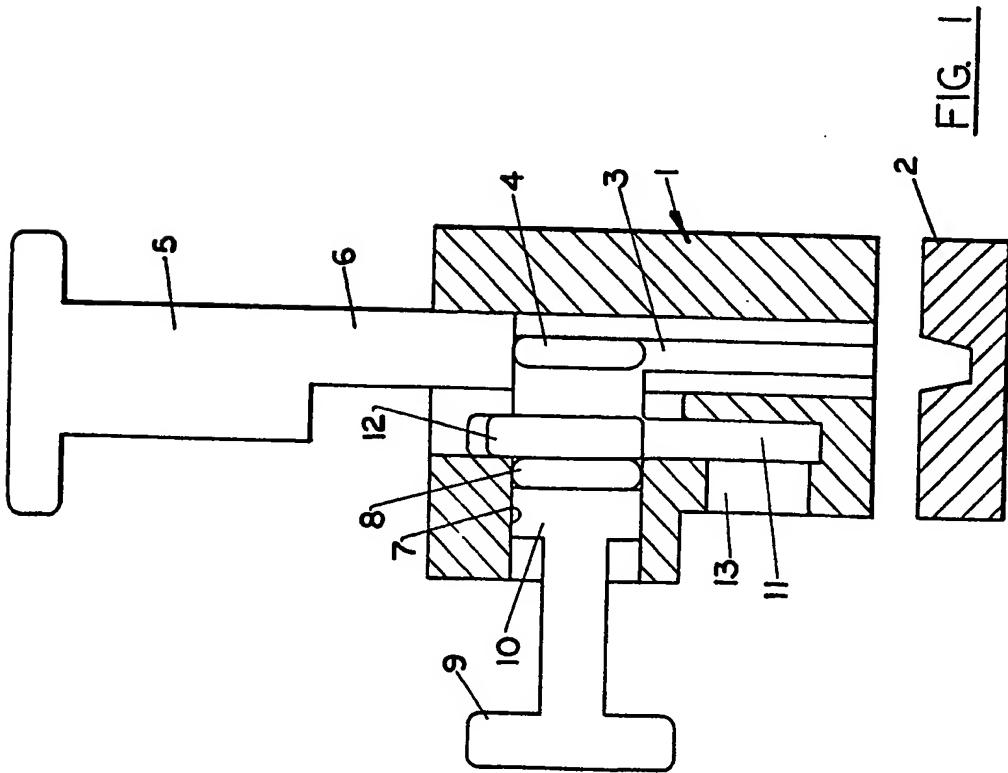


FIG. 1

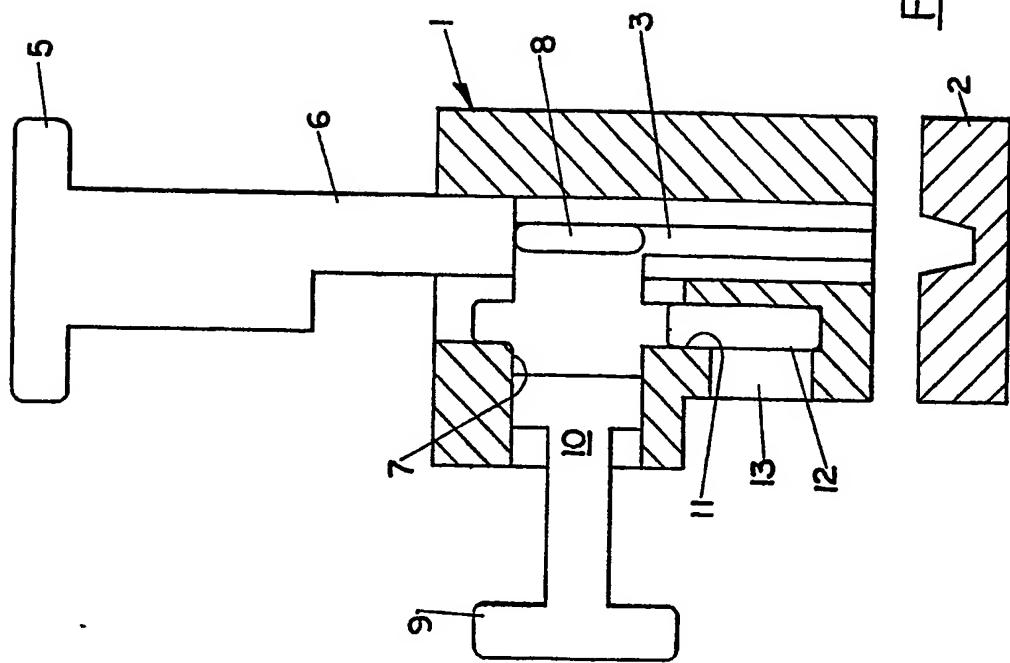


FIG. 4

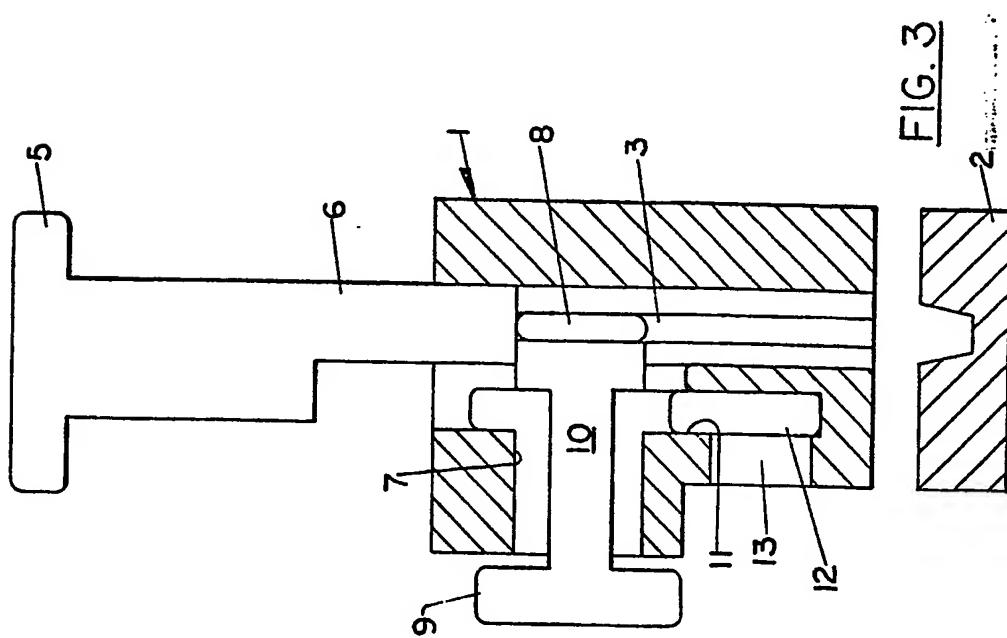


FIG. 3

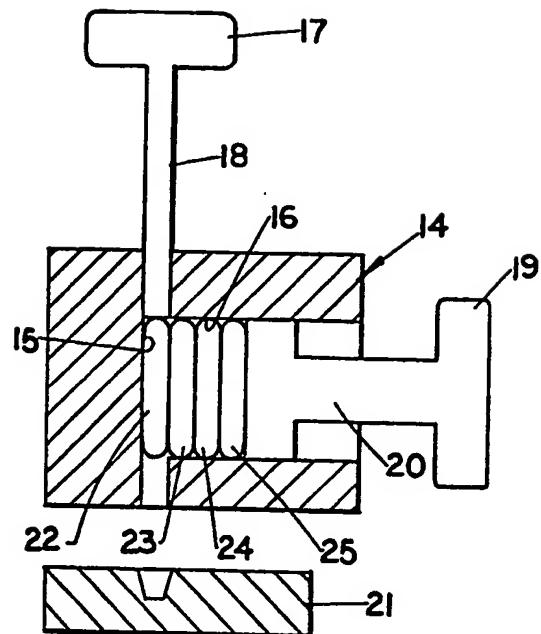


FIG. 5

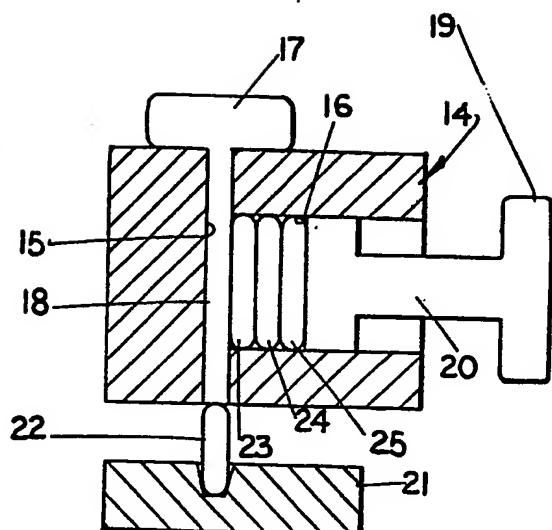


FIG. 6

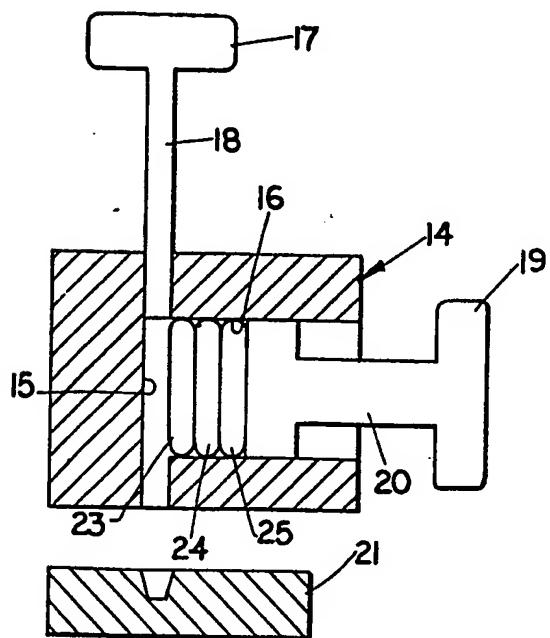


FIG. 7

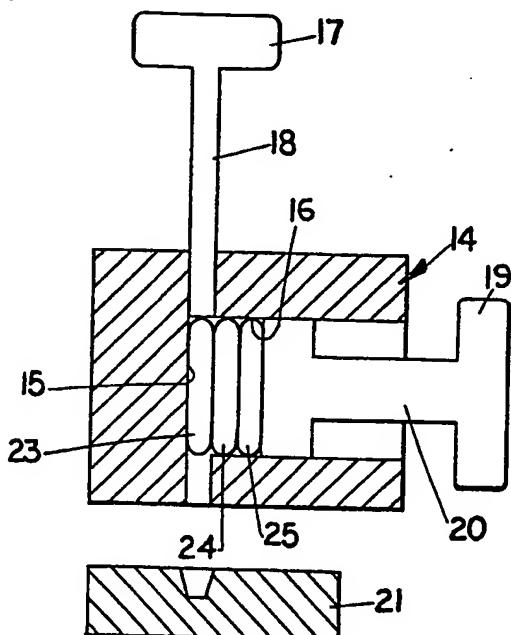


FIG. 8

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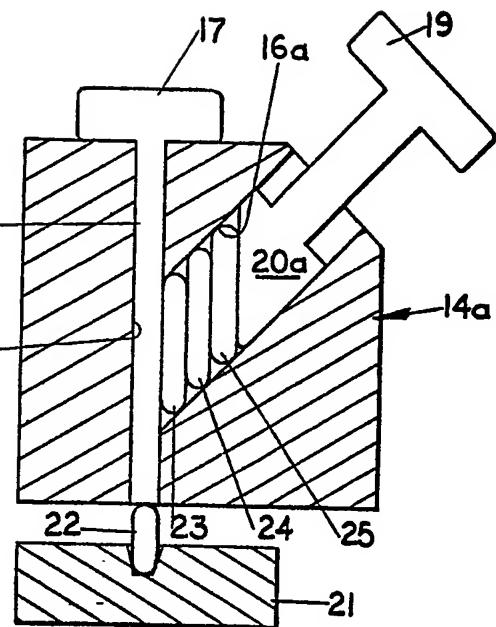
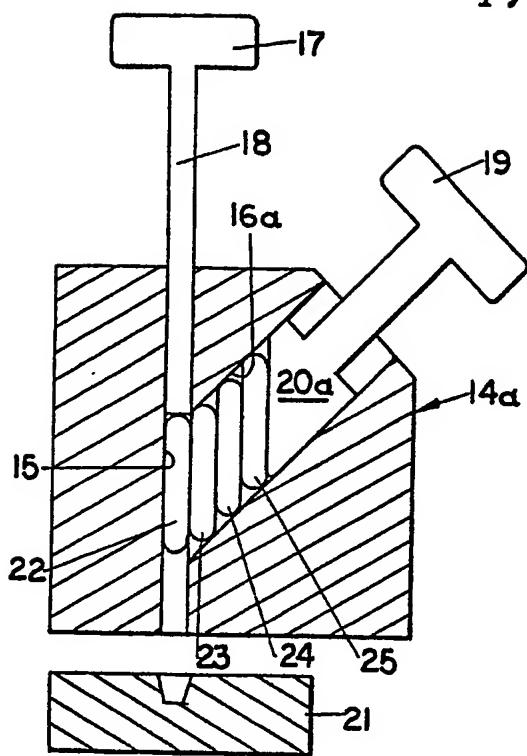


FIG. 9

FIG. 10

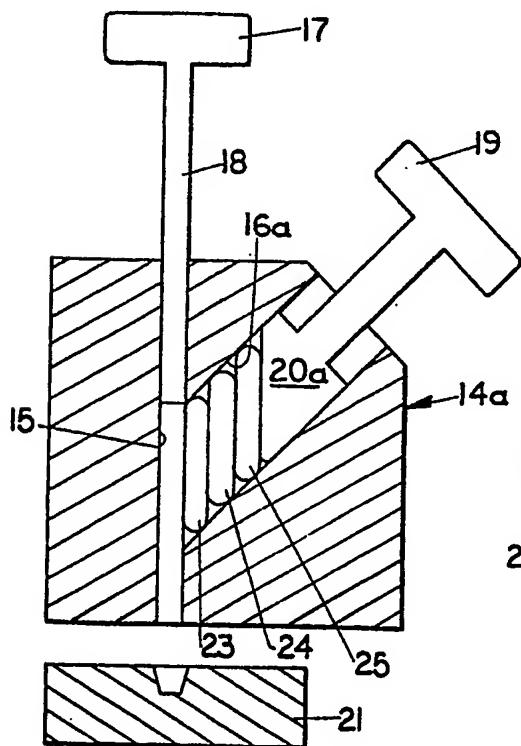


FIG. 11

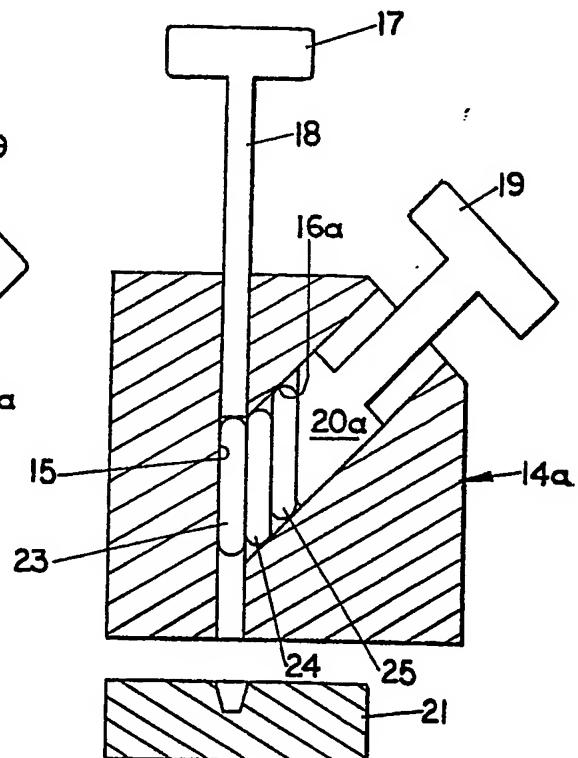


FIG. 12

FIG. 14

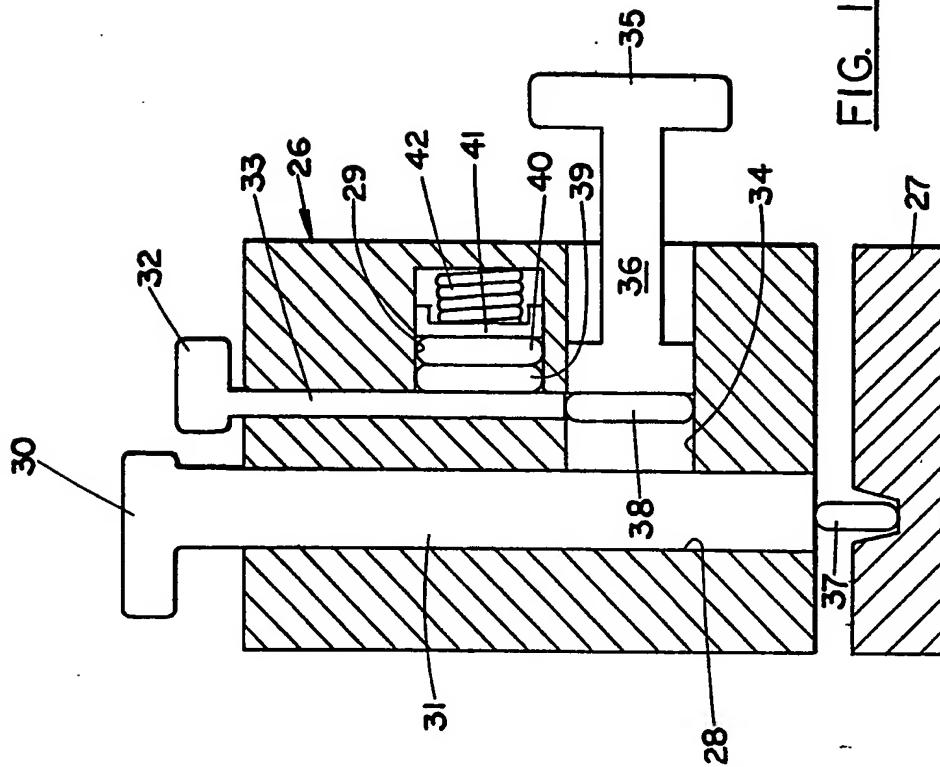
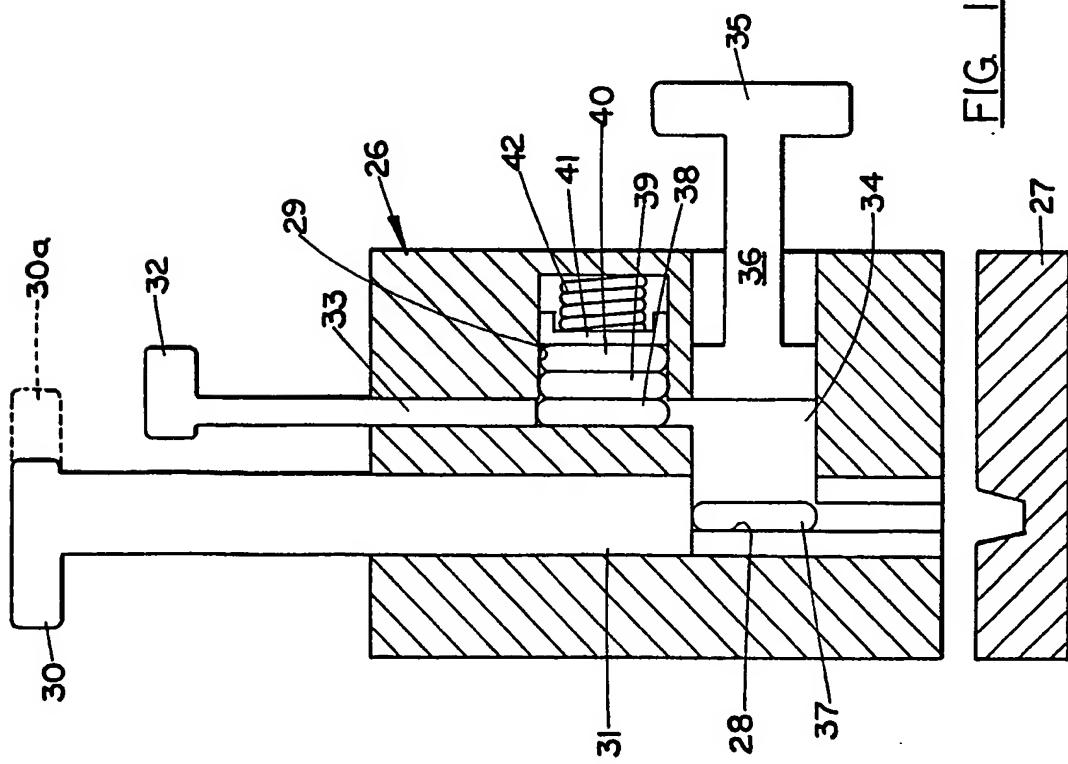
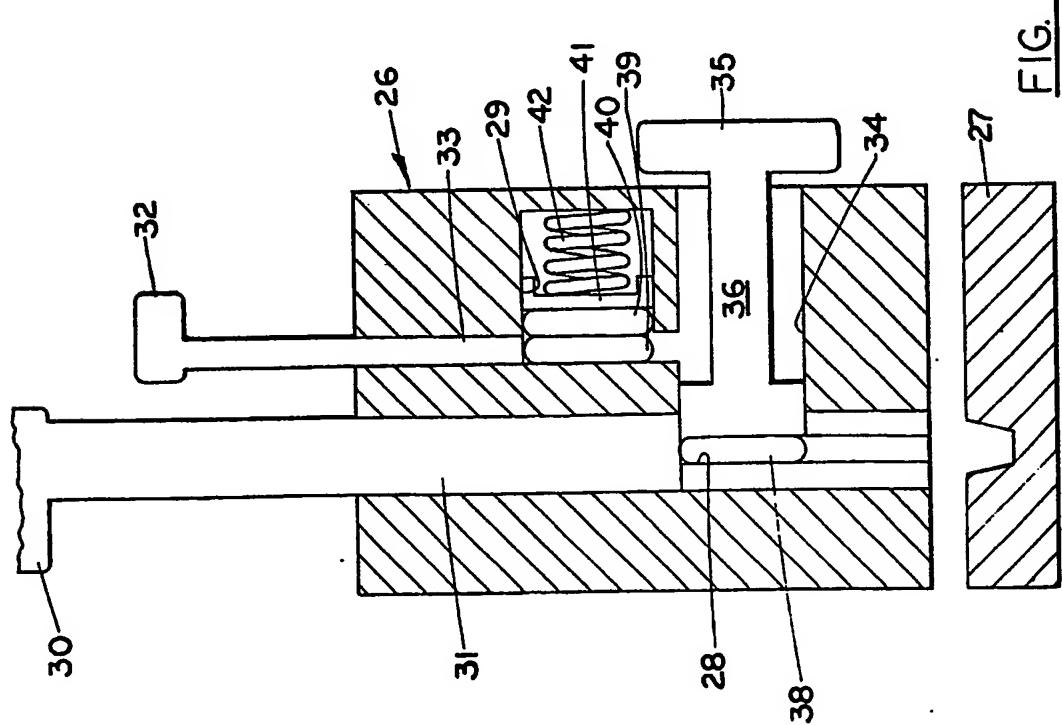
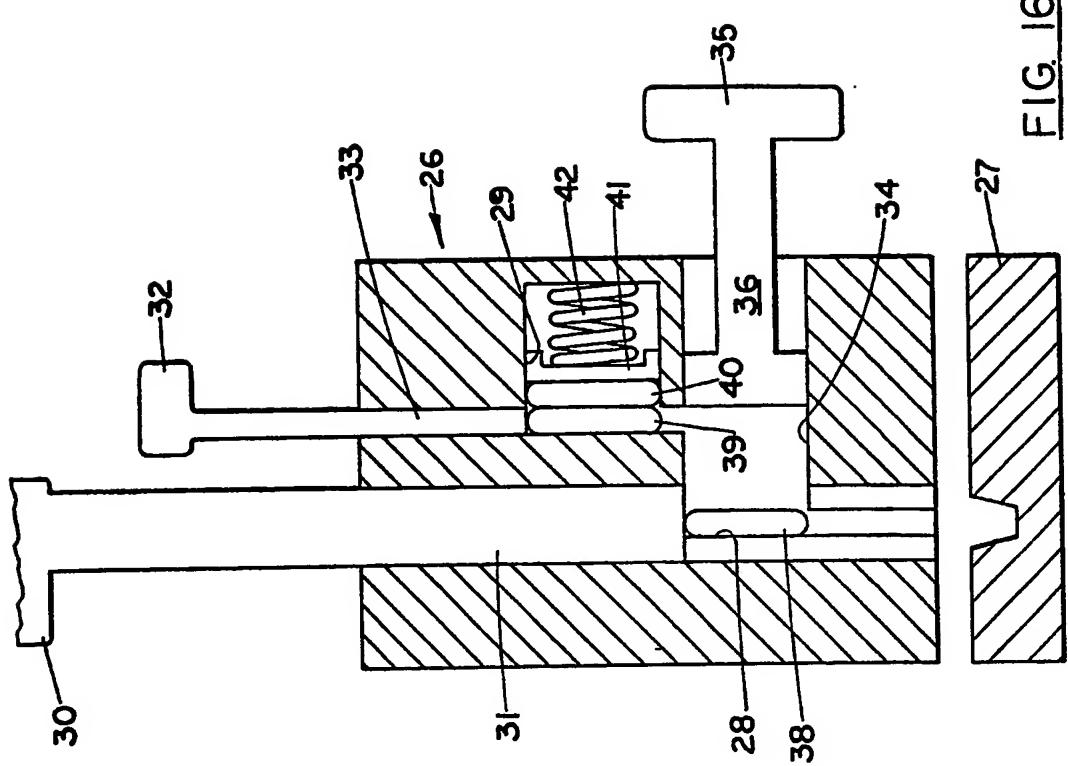


FIG. 13





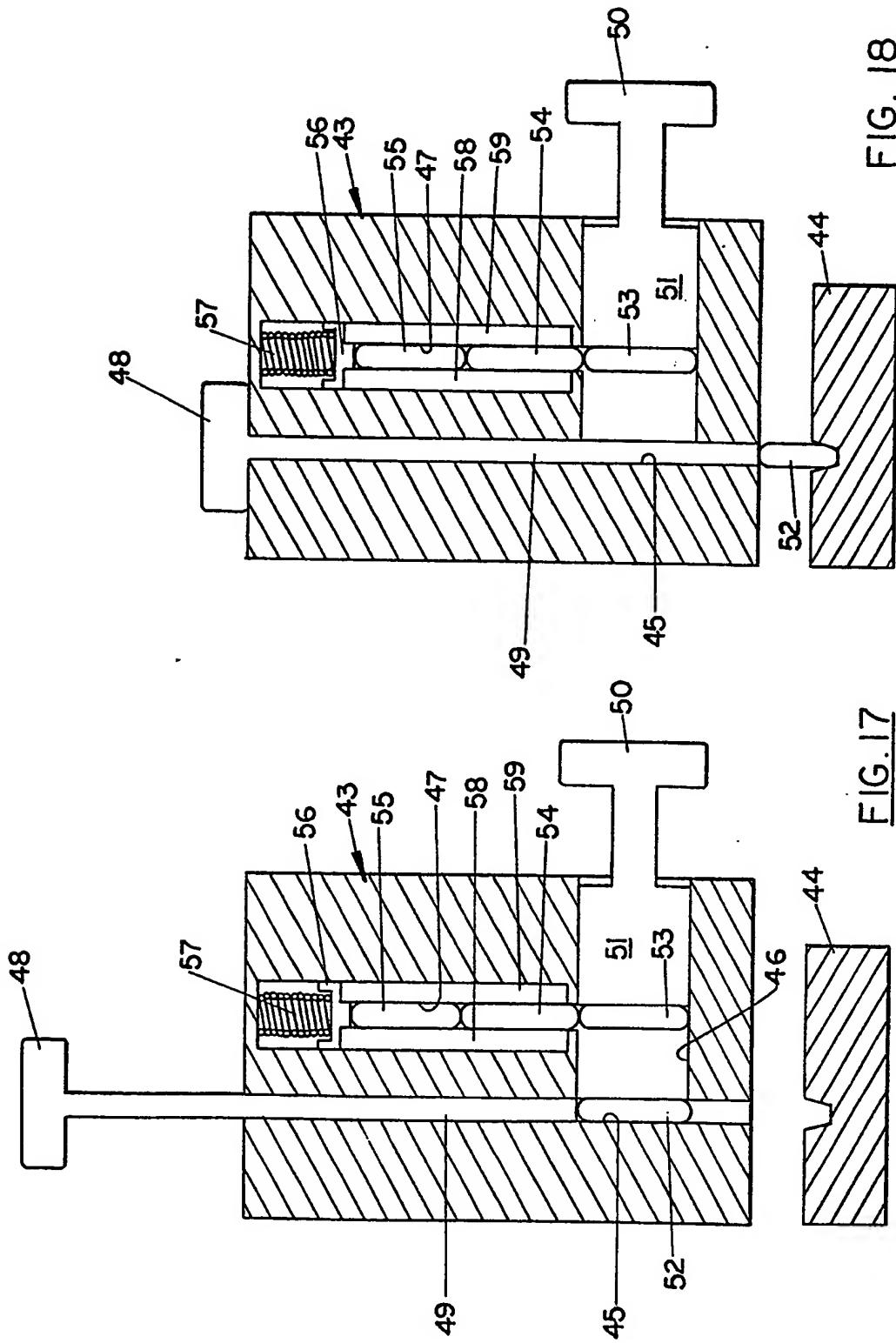
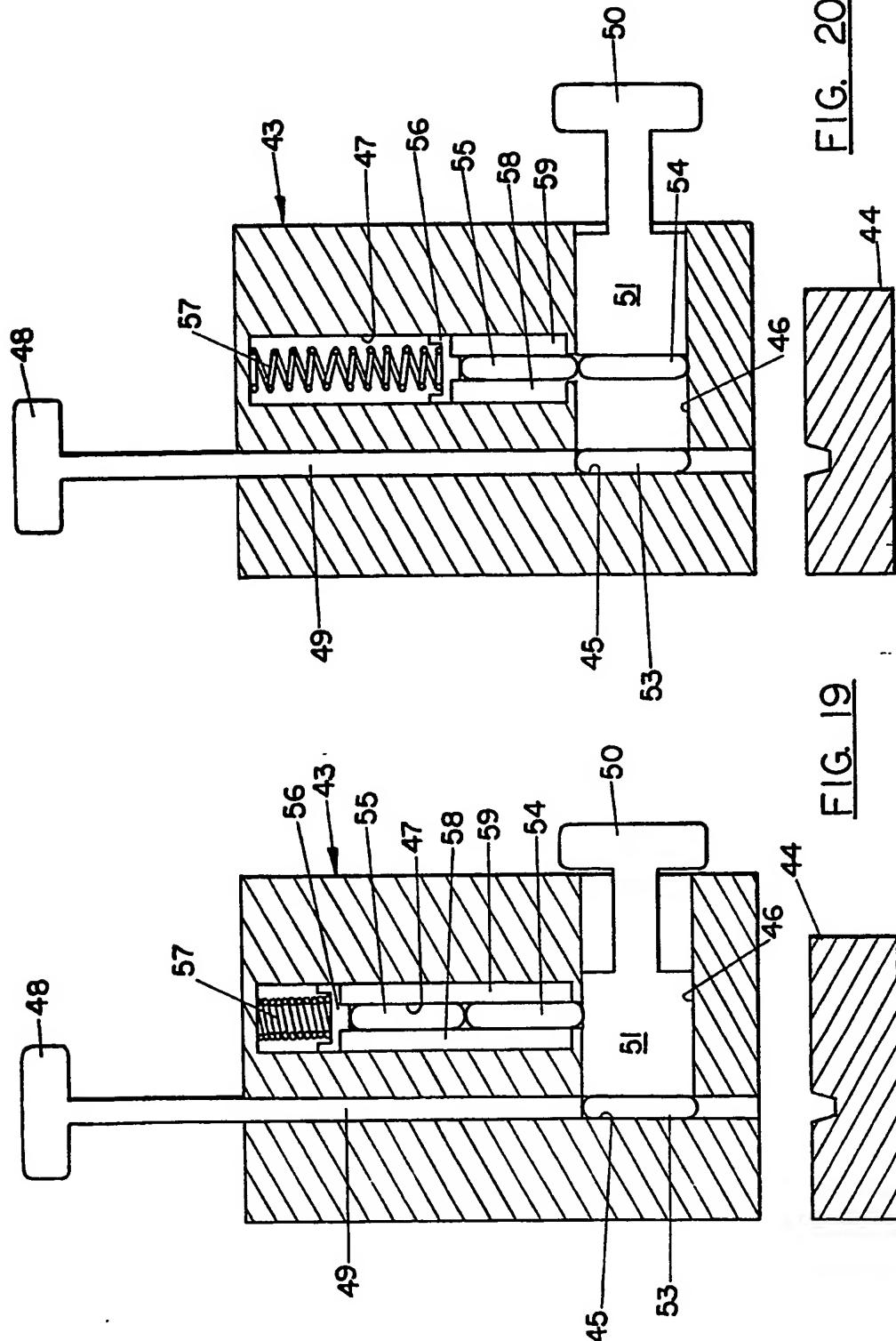


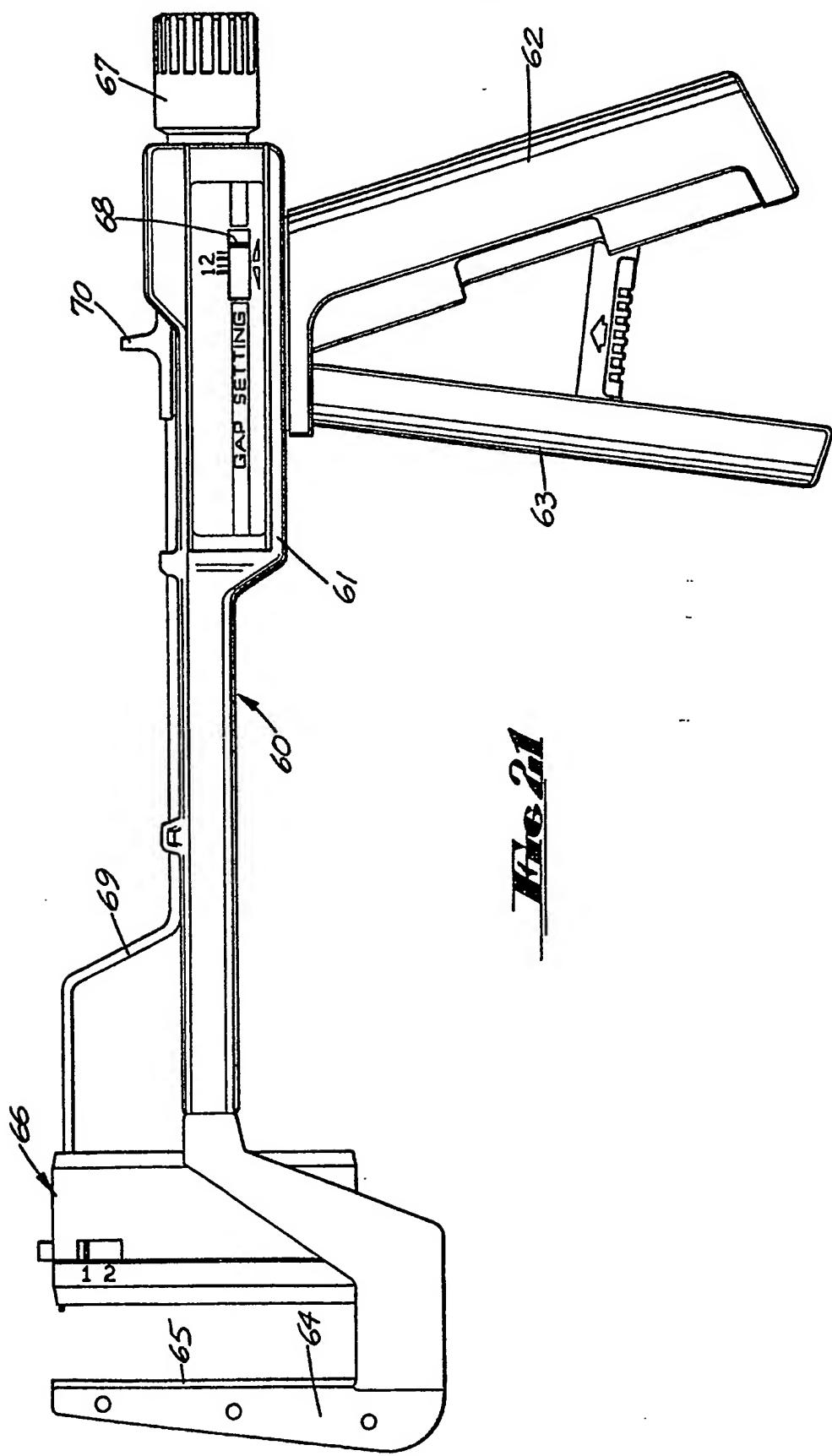
FIG. 18

FIG. 17



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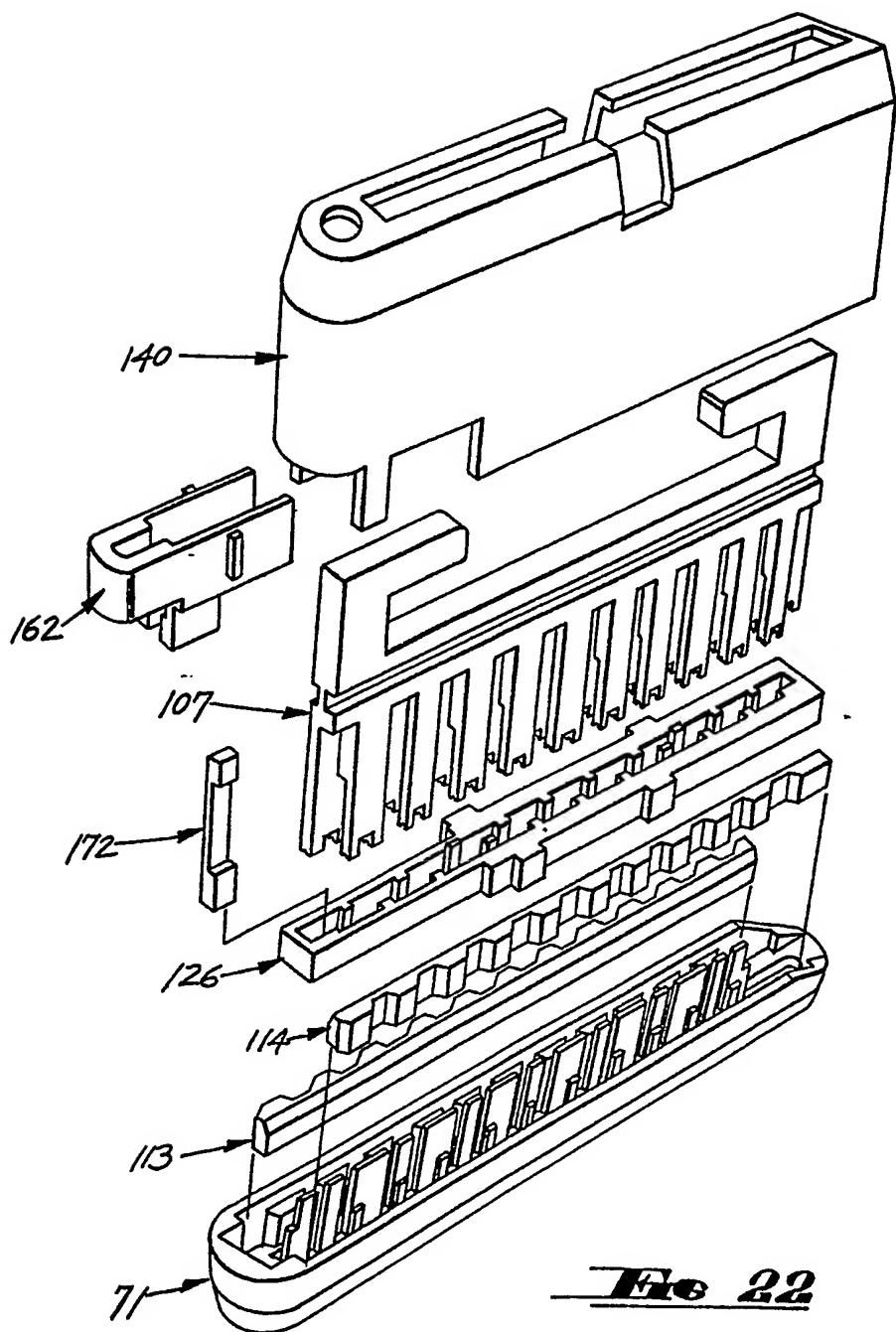
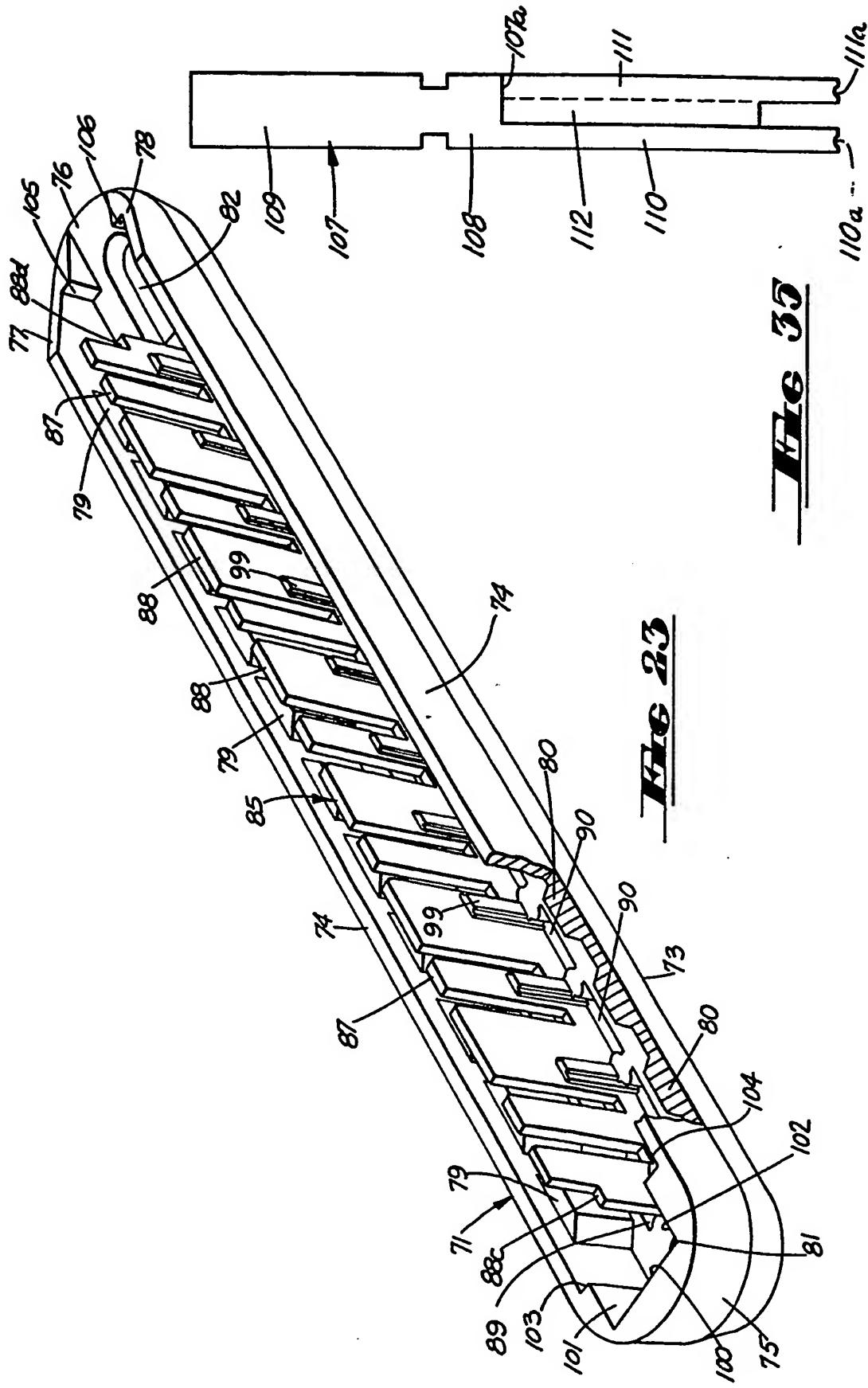


Fig 22

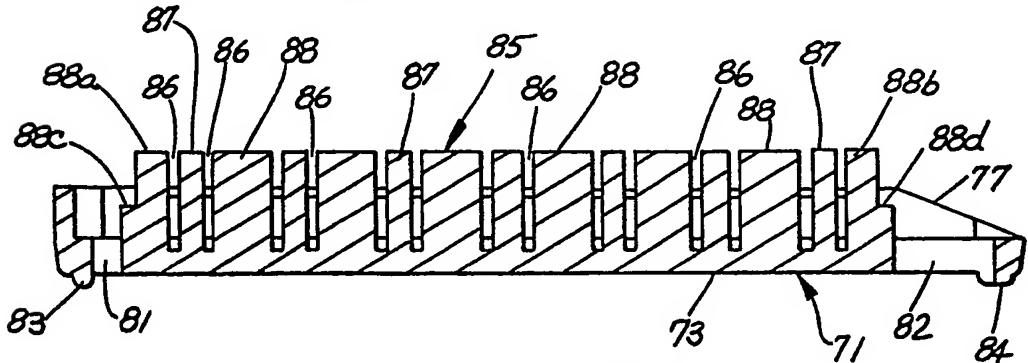
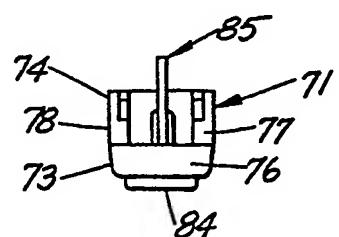
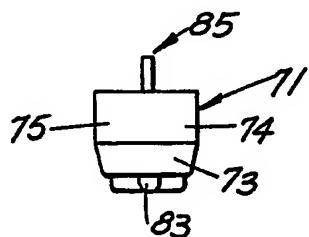
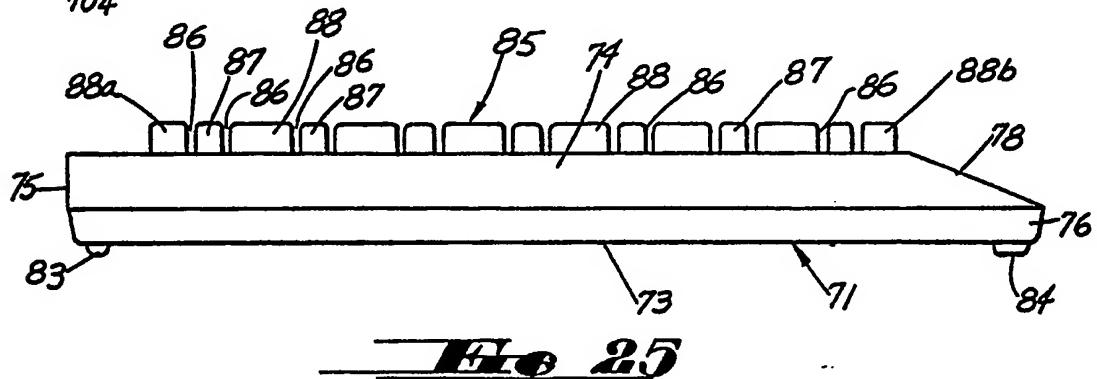
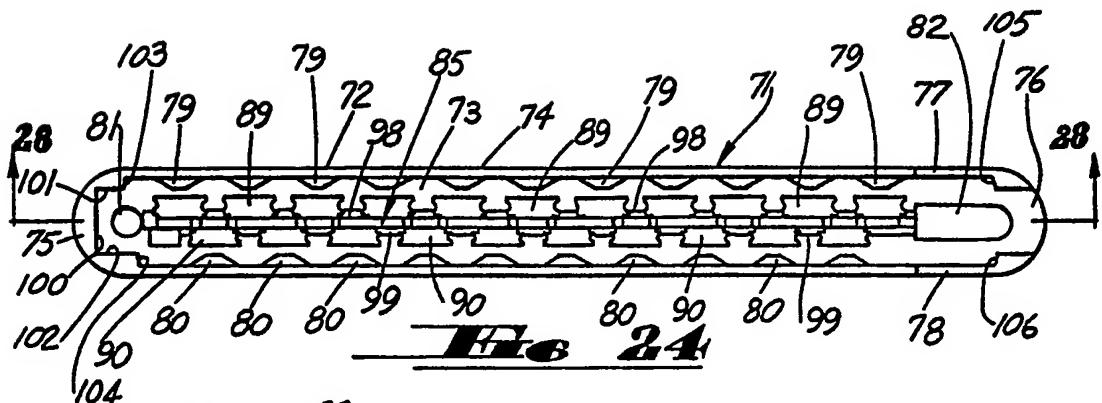
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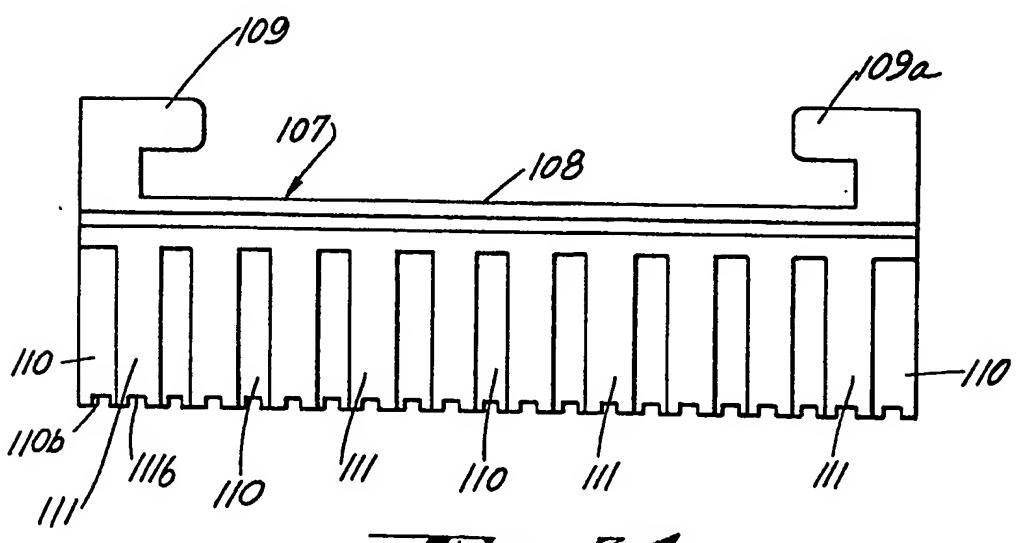
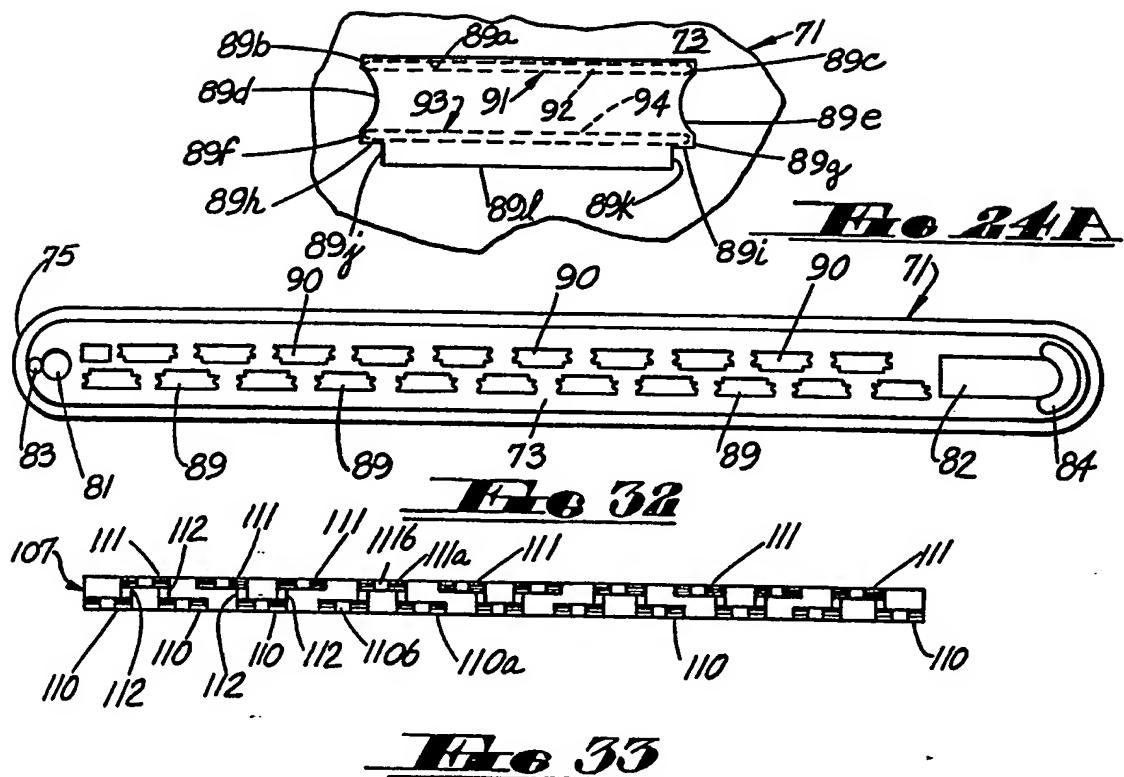
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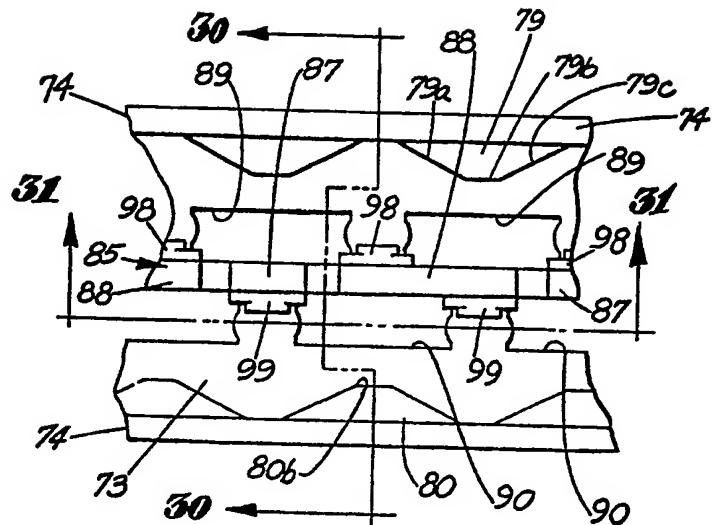


Fig 29

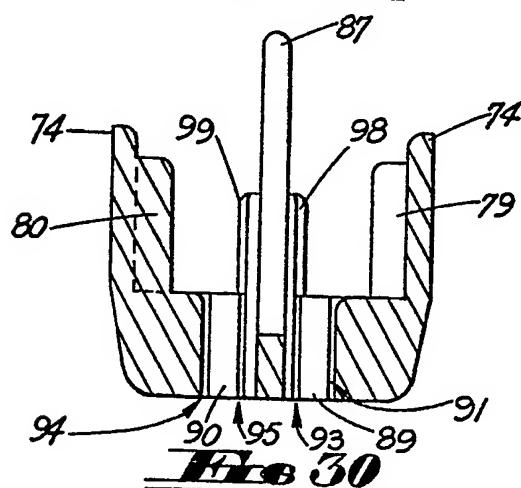


Fig 30

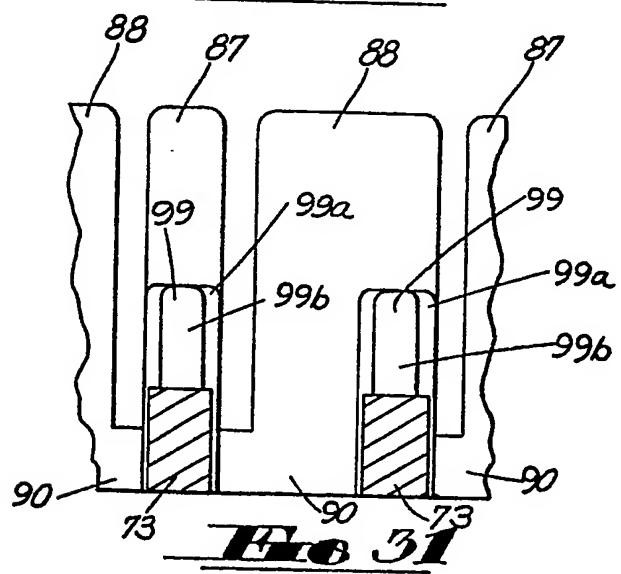
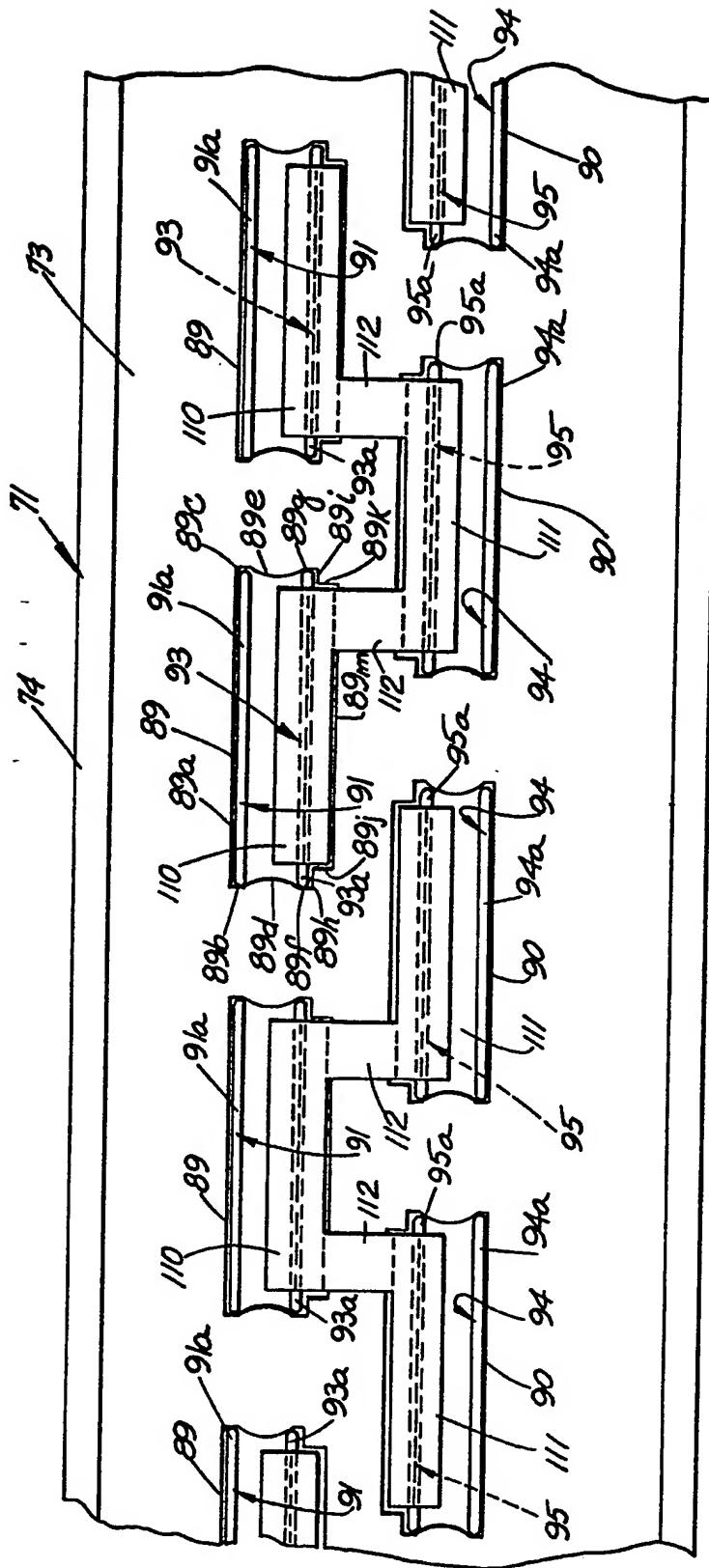


Fig 31

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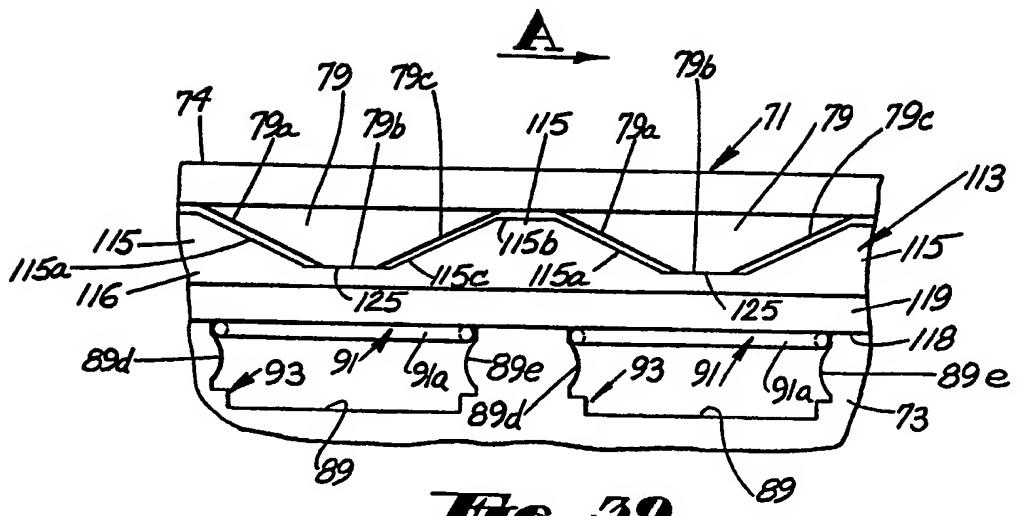


Fig. 39

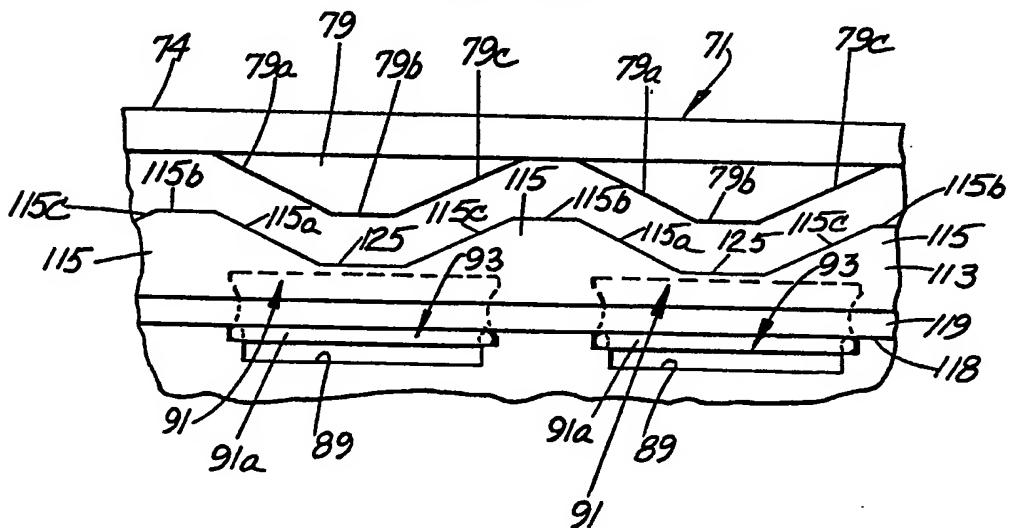


Fig. 40

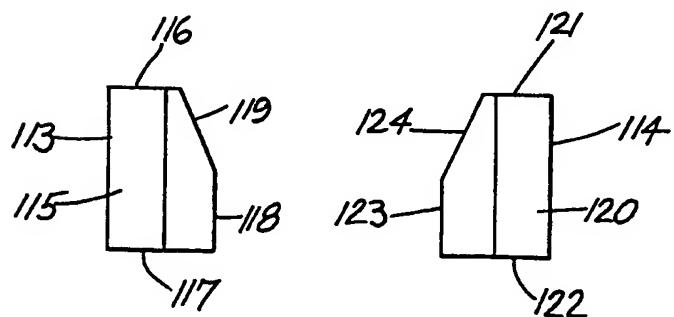
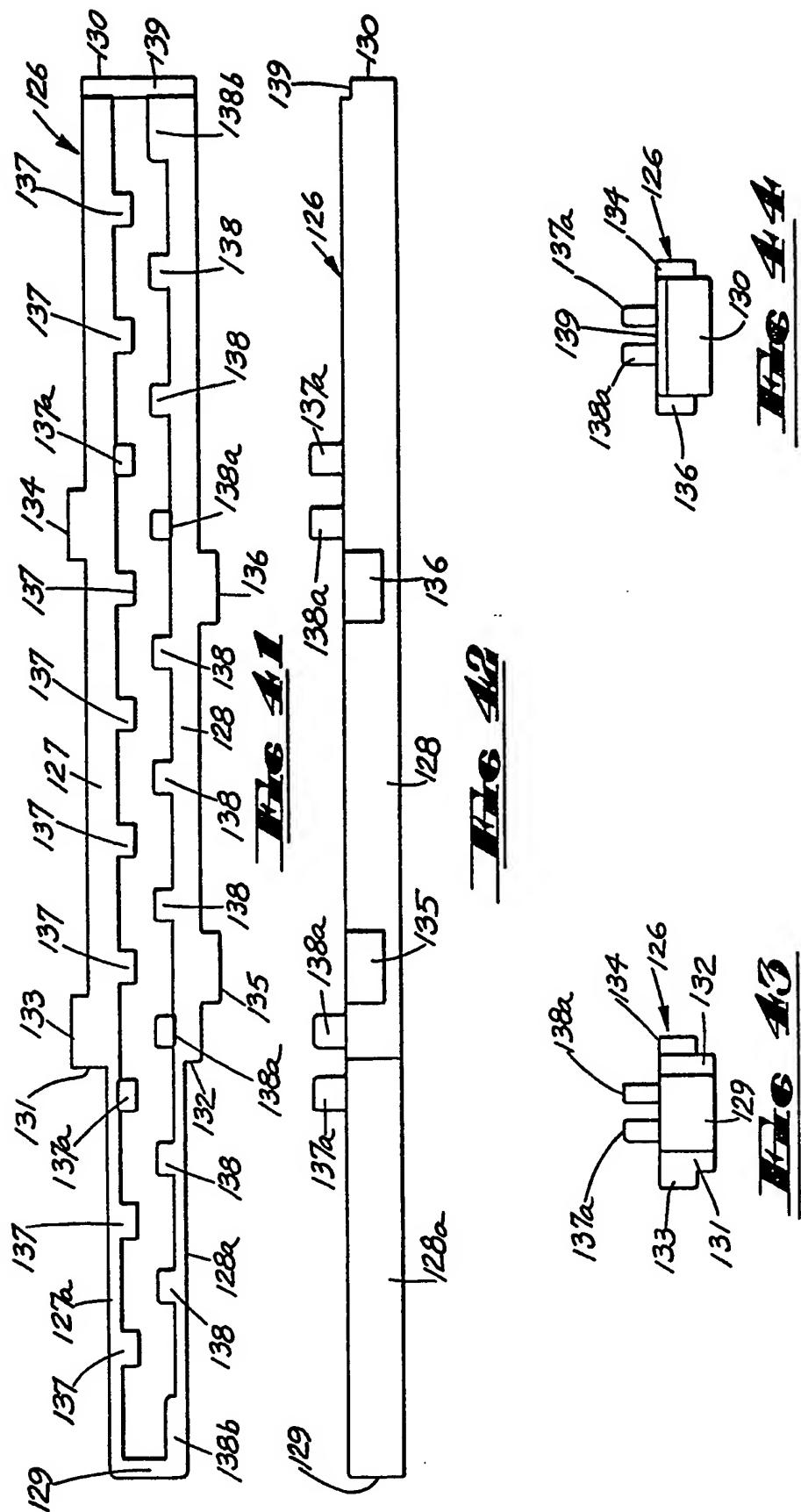


Fig. 37

Fig. 38

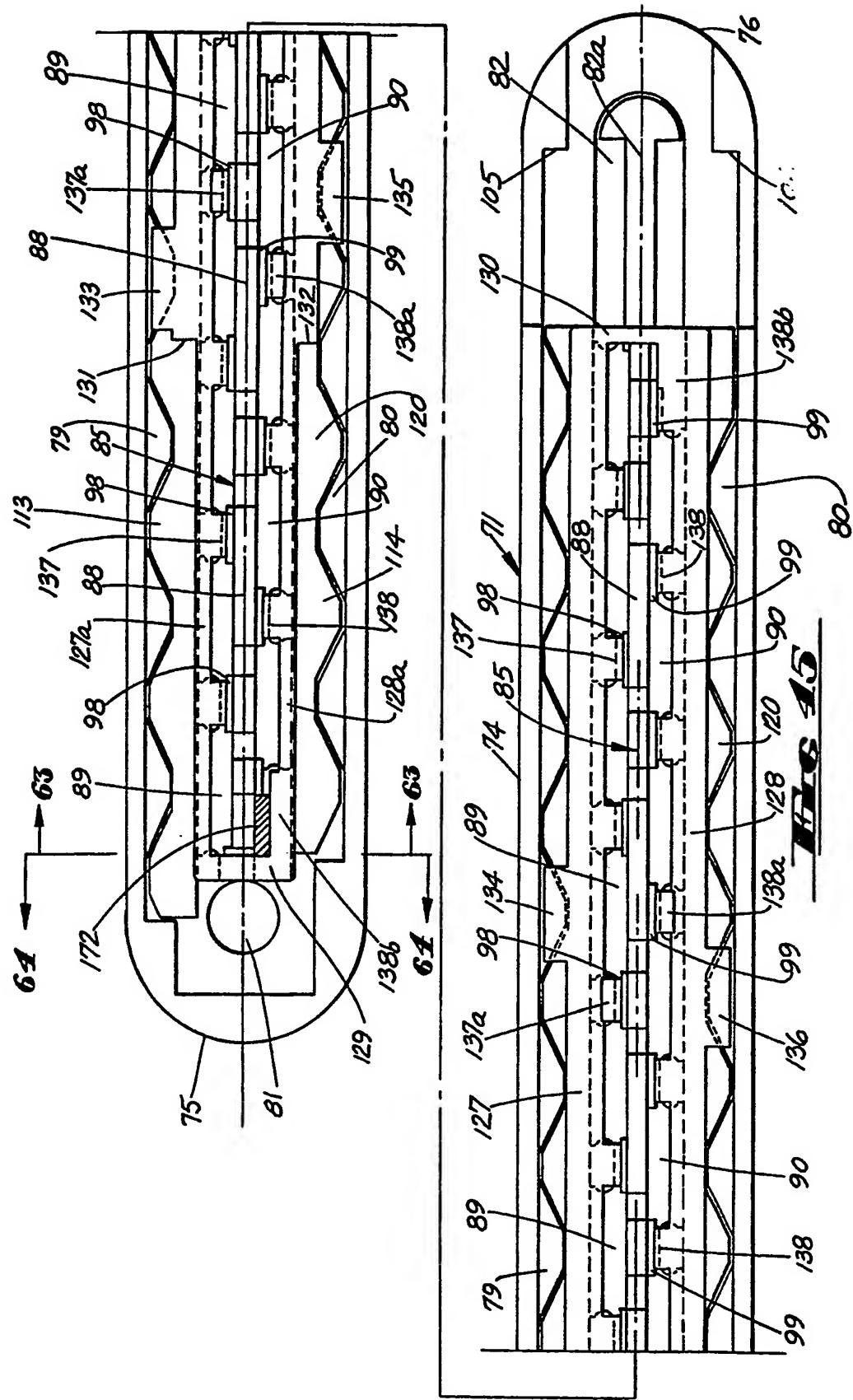
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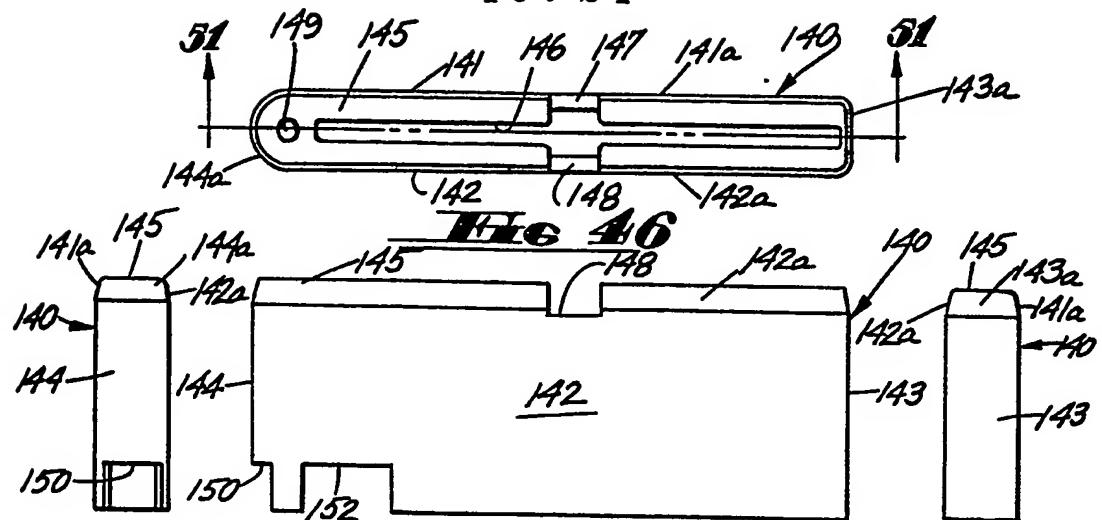
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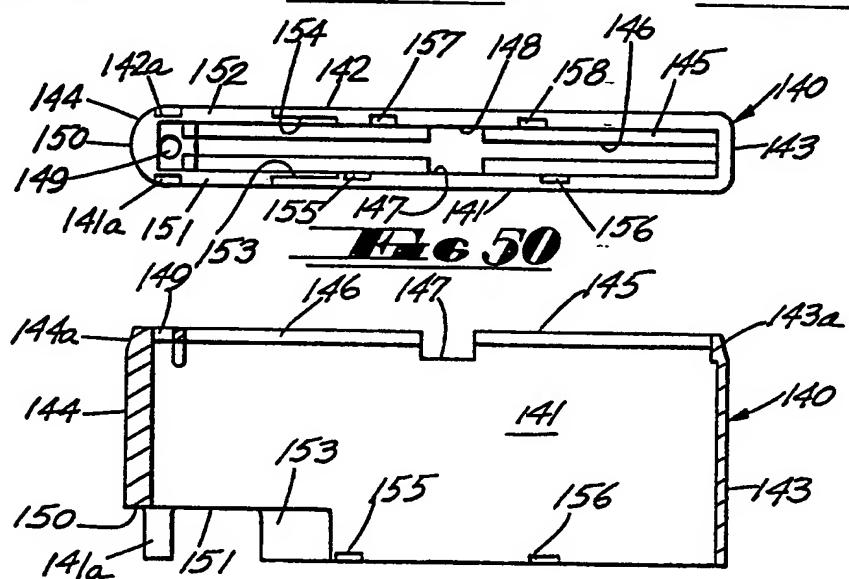
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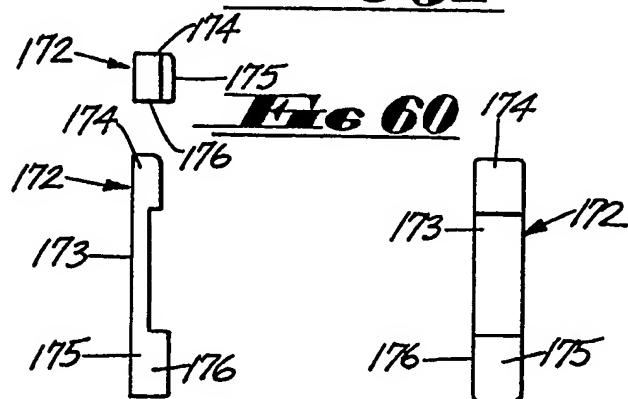
Re 49

EG 47

Re 48



The 51

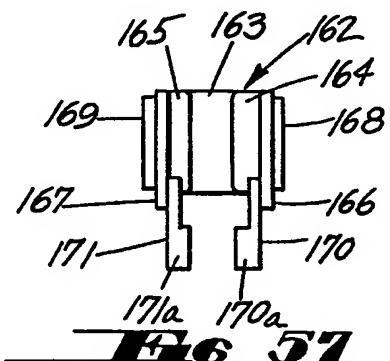
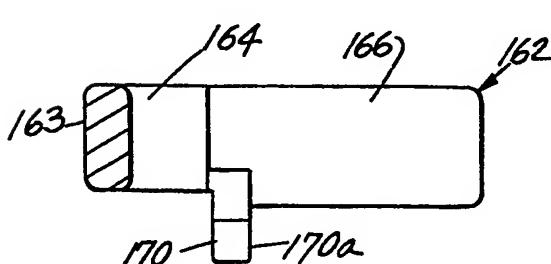
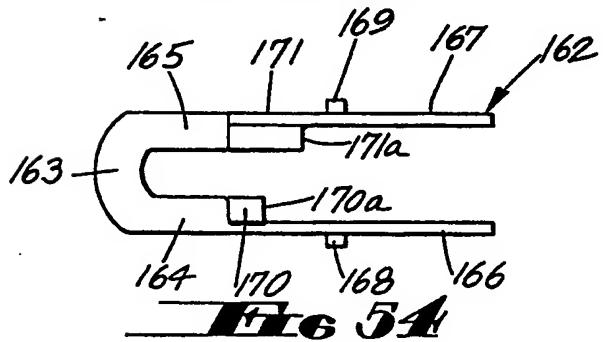
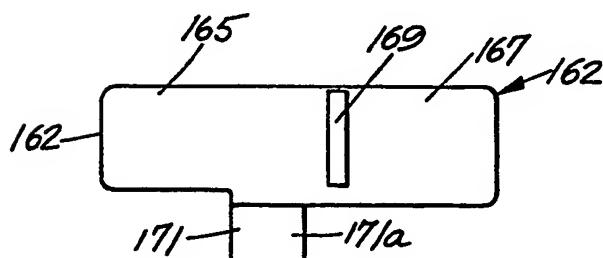
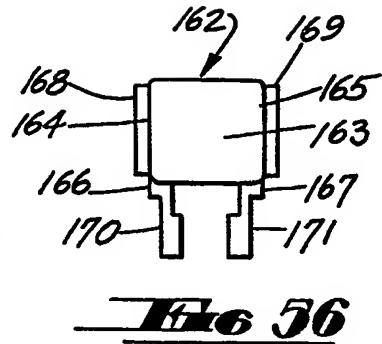
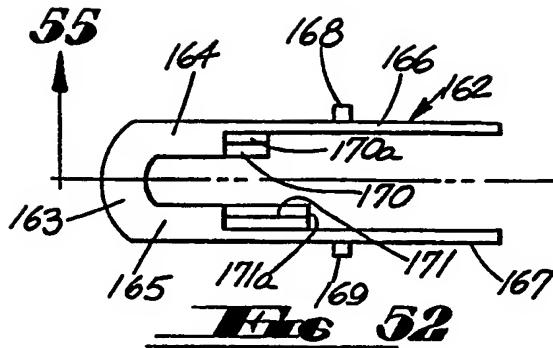


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Be 62

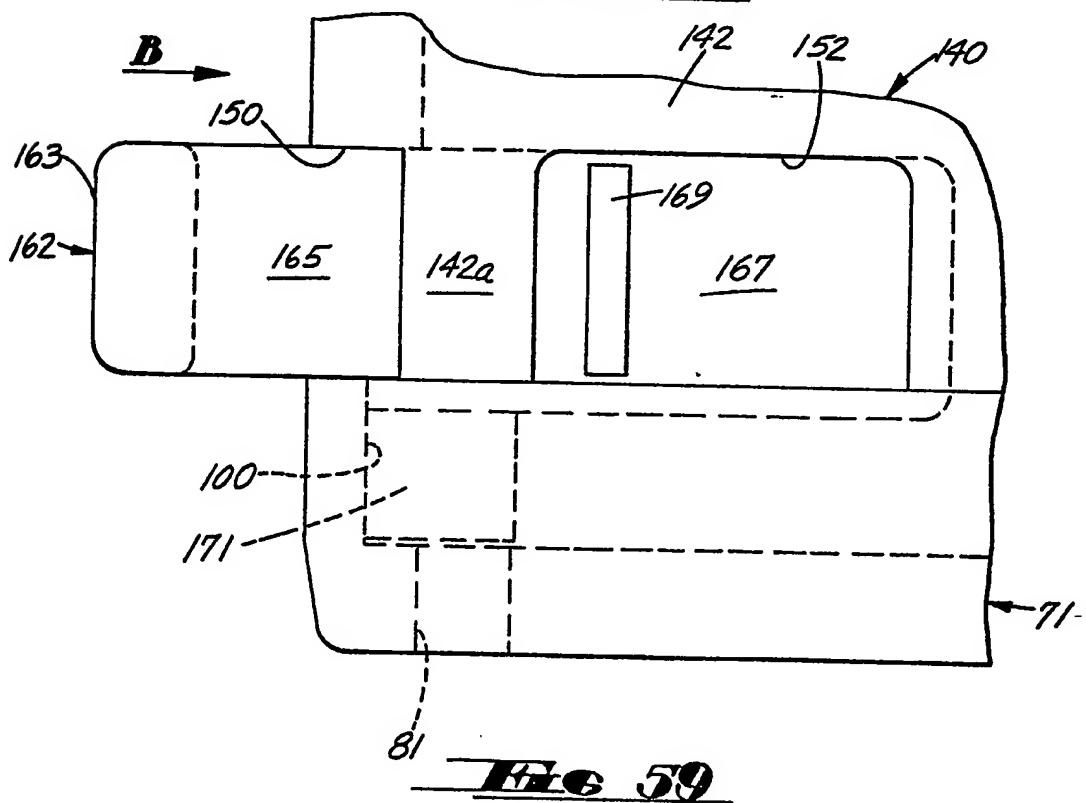
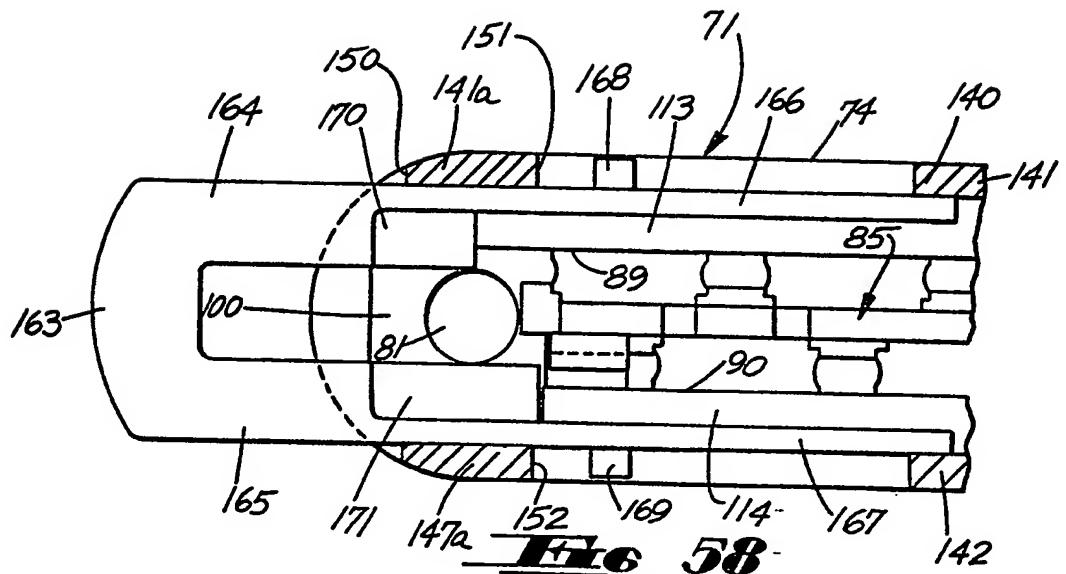
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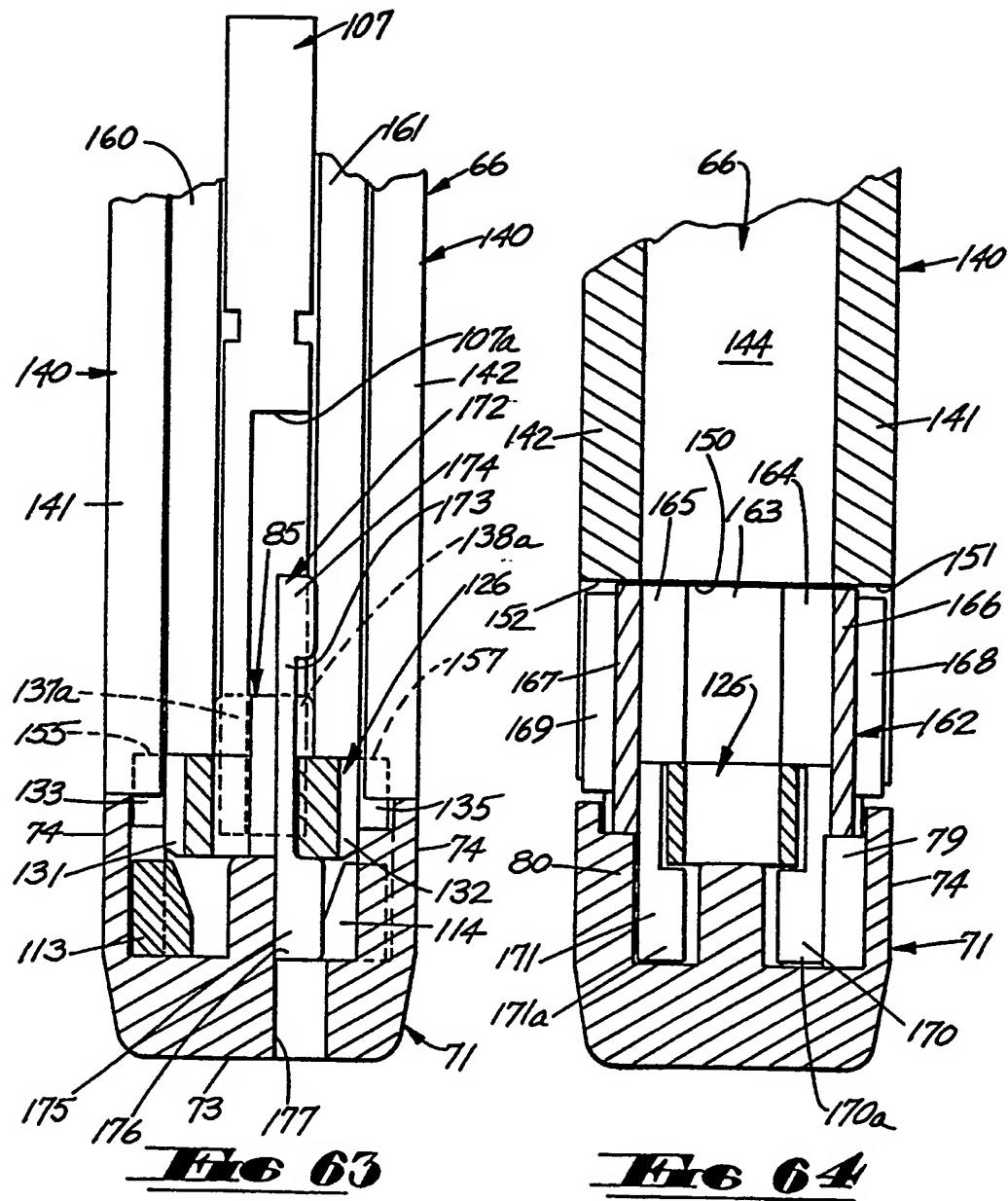
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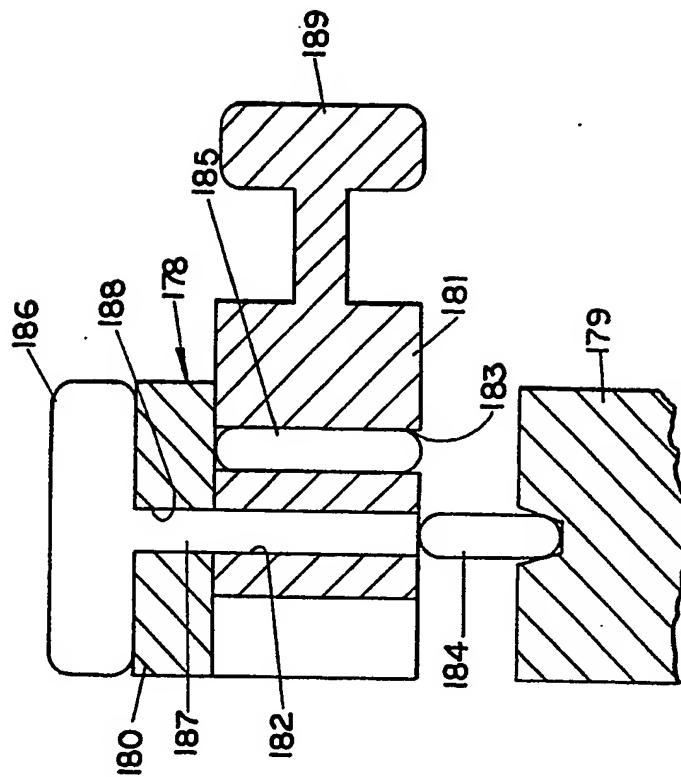


FIG. 66

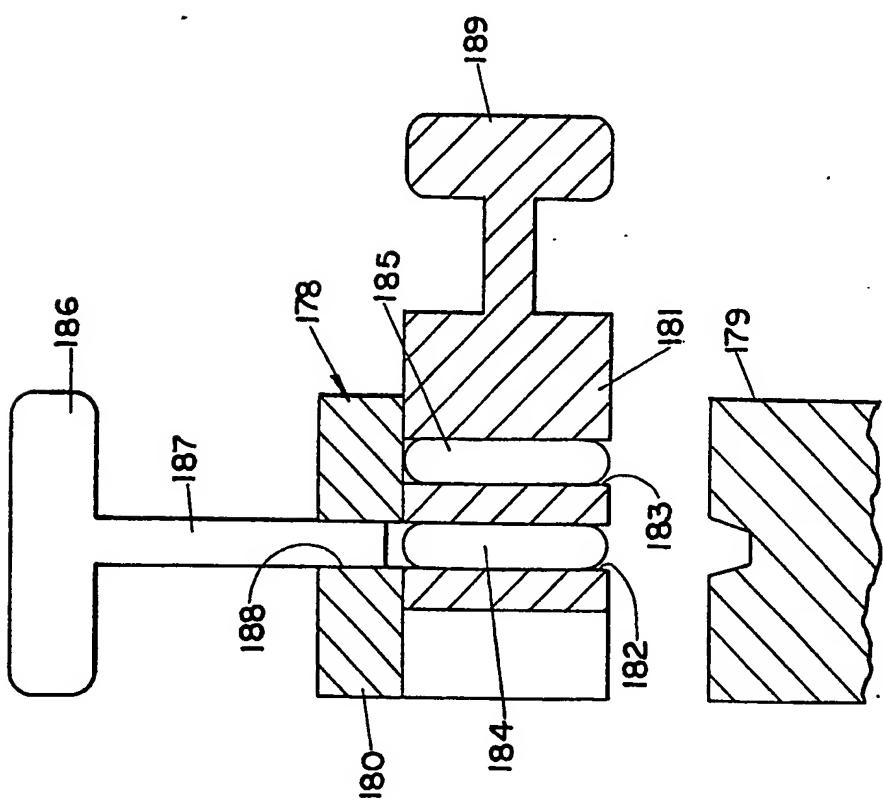


FIG. 65

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